GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1999

By

C.B. Burden, L.E. Spangler, and others

U.S. Geological Survey

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Division of Water Resources and

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CONVERSION FACTORS

Multiply	By	To obtain
acre-foot	1,233	cubic meter
foot	0.3048	meter
gallon per minute	0.06308	liter per second
inch	25.4	millimeter
mile	1.609	kilometer
square mile	2.590	square kilometer

Chemical concentration is reported only in metric units—milligrams per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

DEFINITION OF TERMS

Acre-foot—The quantity of water required to cover 1 acre to a depth of 1 foot; equal to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

Aquifer—A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield substantial amounts of water to wells and springs.

Artesian—Describes a well in which the water level stands above the top of the aquifer tapped by the well (confined). A flowing artesian well is one in which the water level is above the land surface.

Dissolved—Material in a representative water sample that passes through a 0.45–micron membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.

Land-surface datum (lsd)—A datum plane that is approximately at land surface at each ground-water observation well.

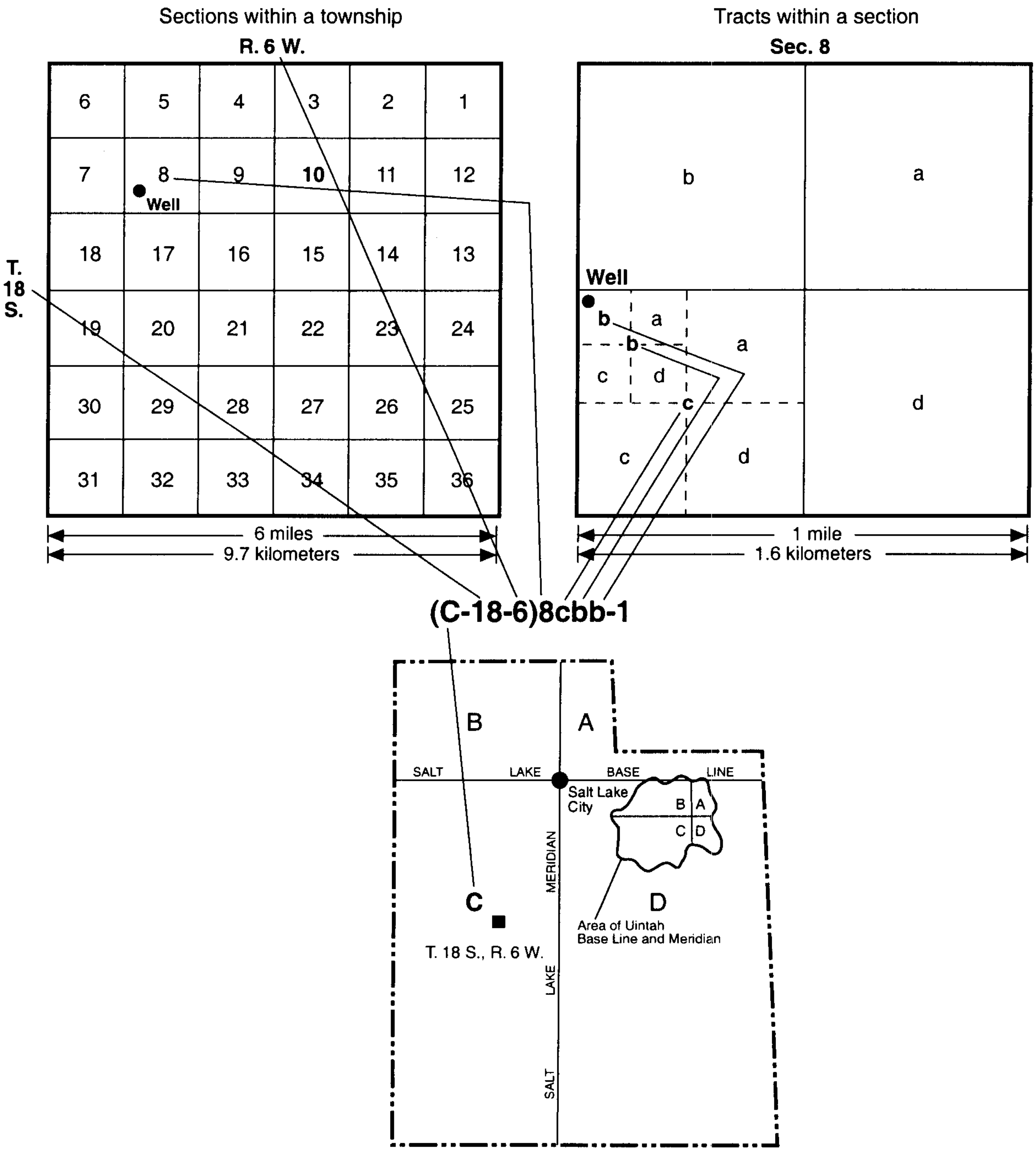
Milligrams per liter—A unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represents the mass of solute per unit volume (liter) of water.

Specific conductance—A measure of the ability of water to conduct an electrical current. It is expressed in microsiemens per centimeter at 25 degrees Celsius. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids concentration of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in microsiemens). This relation is not constant in water from one well or stream to another, and it may vary for the same source with changes in the composition of the water.

Cumulative departure from average annual precipitation—A graph of the departure or difference between the average annual precipitation and the value of precipitation for each year, plotted cumulatively. A cumulative plot is generated by adding the departure from average precipitation for the current year to the sum of departure values for all previous years in the period of record. A positive departure, or greater-than-average precipitation, for a year results in a graph segment trending upward; a negative departure results in a graph segment trending downward. A generally downward-trending graph for a period of years represents a period of generally less-than-average precipitation, which commonly causes and corresponds with declining water levels in wells. Likewise, a generally upward-trending graph for a period of years represents a period of greater-than-average precipitation, which commonly causes and corresponds with rising water levels in wells. However, increases or decreases in withdrawals of ground water from wells also affect water levels and can change or eliminate the correlation between water levels in wells and the graph of cumulative departure from average precipitation.

WELL-NUMBERING SYSTEM

The well-numbering system used in Utah is based on the Bureau of Land Management's system of land subdivision. The well-numbering system is familiar to most water users in Utah, and the well number shows the location of the well by quadrant, township, range, section, and position within the section. Well numbers for most of the State are derived from the Salt Lake Base Line and the Salt Lake Meridian. Well numbers for wells located inside the area of the Uintah Base Line and Meridian are designated in the same manner as those based on the Salt Lake Base Line and Meridian, with the addition of the "U" preceding the parentheses. The numbering system is illustrated below.



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INTRODUCTION

This is the thirty-sixth in a series of annual reports that describe ground-water conditions in Utah. Reports in this series, published cooperatively by the U.S. Geological Survey and the Utah Department of Natural Resources, Division of Water Resources and Division of Water Rights, provide data to enable interested parties to maintain awareness of changing ground-water conditions.

This report, like the others in the series, contains information on well construction, ground-water withdrawal from wells, water-level changes, precipitation, streamflow, and chemical quality of water. Information on well construction included in this report refers only to wells constructed for new appropriations of ground water. Supplementary data are included in reports of this series only for those years or areas which are important to a discussion of changing ground-water conditions and for which applicable data are available.

This report includes individual discussions of selected significant areas of ground-water development in the State for calendar year 1998. Most of the reported data were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Divisions of Water Rights and Water Resources.

The following reports deal with ground water in the State and were printed by the U.S. Geological Survey or by cooperating agencies from May 1998 through April 1999:

Ground-water conditions in Utah, spring of 1998, by D.D. Susong, C.B. Burden, and others, Utah Division of Water Resources Cooperative Investigations Report No. 39.

Hydrology of the Bonneville Salt Flats, northwestern Utah, and simulation of ground-water flow and solute transport in the shallow-brine aquifer, by J.L. Mason, and K.L. Kipp, Jr., U.S. Geological Survey Professional Paper 1585.

Ground-water hydrology and simulated effects of development in the Milford Area, an arid basin in southwestern Utah, by J.L. Mason, U.S. Geological Survey Professional Paper 1409-G.

Hydrology and snowmelt simulation of Snyderville Basin, Park City, and adjacent areas, Summit County, Utah, by L.E. Brooks, J.L. Mason, and D.D. Susong, Utah Department of Natural Resources Technical Publication No. 115.

Water resources in the area of Snyderville Basin and Park City in Summit County, Utah, by D.D. Susong, L.E. Brooks, and J.L. Mason, U.S. Geological Survey Fact Sheet 099-98.

Selected hydrologic data for the central Virgin River basin area, Washington and Iron Counties, Utah, 1915-97, C.D. Wilkowske, V.M. Heilweil, and D.E. Wilberg, U.S. Geological Survey Open-File Report 98-389.

UTAH'S GROUND-WATER RESERVOIRS

Small amounts of ground water can be obtained from wells throughout most of Utah, but large amounts that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The areas of ground-water development discussed in this report are shown in figure 1 and listed in table 1. Relatively few wells outside of these areas yield large amounts of ground water of suitable chemical quality for the uses listed above, although some of the basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

About 2 percent of the wells in Utah yield water from consolidated rock. Consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings, fractures, or permeable weathered zones at the tops of flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most of the wells that penetrate consolidated rock are in the eastern and southern parts of the State in areas where water cannot be obtained readily from unconsolidated deposits.

About 98 percent of the wells in Utah yield water from unconsolidated deposits. These deposits may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. The largest yields are obtained from coarse materials that are sorted into deposits of uniform grain size. Most wells that yield water from unconsolidated deposits are in large intermountain basins that have been partly filled with rock material eroded from the adjacent mountains.

SUMMARY OF CONDITIONS

The total estimated withdrawal of water from wells in Utah during 1998 was about 747,000 acre-feet (table 2), which is about 56,000 acre-feet less than the total for 1997 and 115,000 acre-feet less than the average annual withdrawal for 1988-97 (table 3). The decrease in withdrawals mostly resulted from decreased irrigation usage. The total estimated withdrawal for irrigation was about 429,000 acre-feet (table 2), which is 40,000 acre-feet less than in 1997. Withdrawal for industrial use was about 61,000 acre-feet, which is about 1,000 acre-feet more than in 1997. Withdrawal for public supply decreased about 16,000 acre-feet to about 194,000 acre-feet. Withdrawal for domestic and stock use was about 63,000 acre-feet, which is about equal to the withdrawal for 1997.

Ground-water withdrawal decreased from 1997 to 1998 in 11 of the 16 areas of ground-water development discussed in this report (table 2). Withdrawal in the Milford area and Utah and Goshen Valleys decreased about 11,000 and 10,000 acre-feet, respectively, the largest decreases among the significant ground-water development areas (fig. 1). Withdrawal increased about 3,000 acre-feet in Parowan Valley and 2,000 acre-feet in Cedar Valley, Iron County, and the Central Virgin River area. The 1998 withdrawal was less than the average annual withdrawals for 1988-97 in 12 of the 16 areas (tables 2 and 3).

The amount of water withdrawn from wells is related to demand and availability of water from other sources, which, in turn, are partly related to local climatic conditions. Precipitation during calendar year 1998 at 27 of 28 weather stations included in this report (National Oceanic and Atmospheric Administration, 1998) was greater than the long-term average. The largest positive departure from average in 1998 was the 8.81 inches recorded at Tooele, and the only negative departure from average was the 3.10 inches recorded at Bluff, in southeastern Utah.

A total of 651 wells were constructed for new appropriations of ground water in 1998, as determined by the Utah Division of Water Rights (table 2). This is 106 fewer wells than was reported for 1997. In 1998, 132 large-diameter wells (12 inches or more) were constructed for new appropriations of ground water (table 2). These are principally for withdrawal of water for public supply, irrigation, and industrial use.

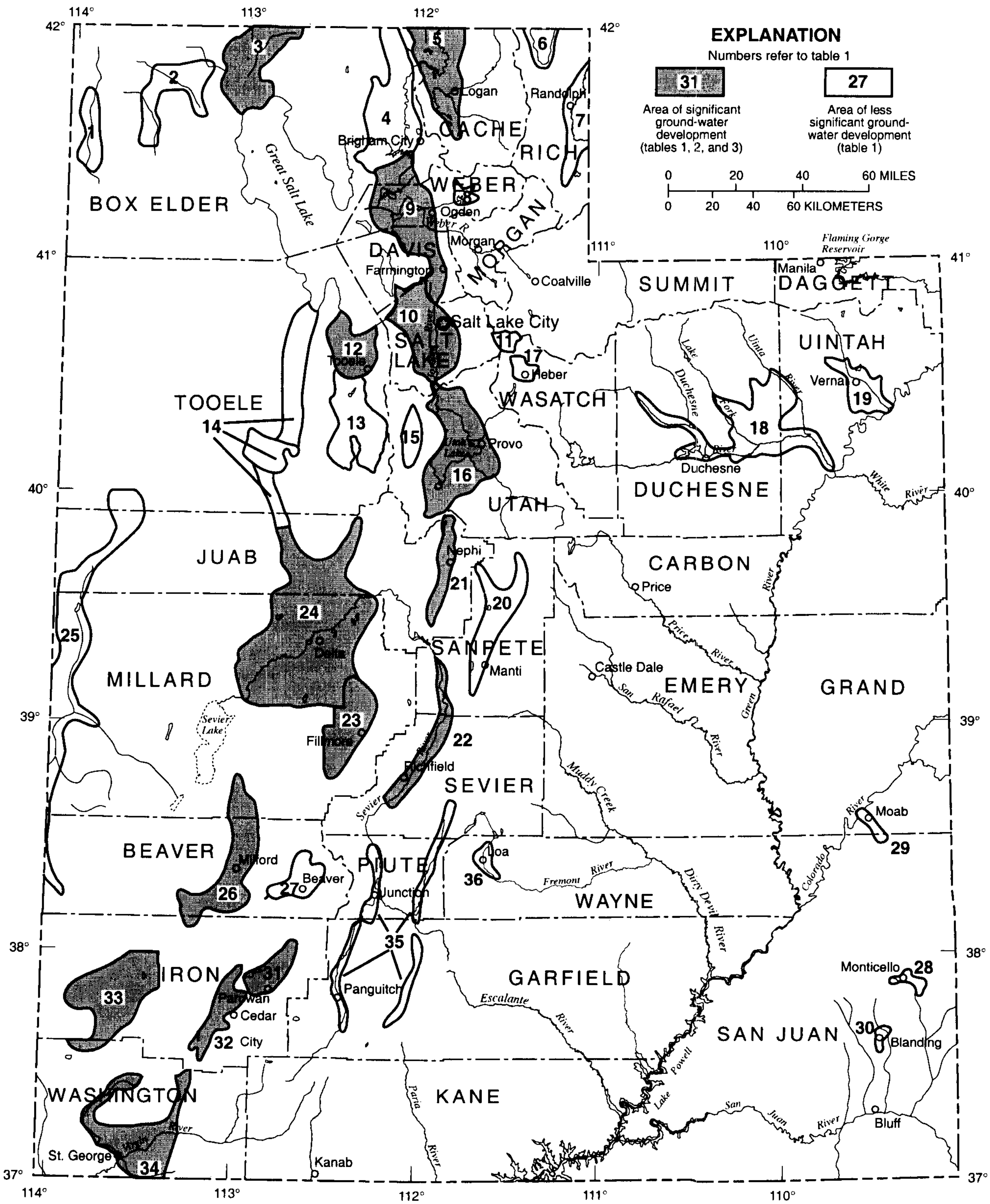


Figure 1. Areas of ground-water development in Utah specifically referred to in this report.

Table 1. Areas of ground-water development in Utah specifically referred to in this report

Number in figure 1	Area	Principal types of water-bearing rocks
1	Grouse Creek Valley	Unconsolidated.
2	Park Valley	Do.
3	Curlew Valley	Unconsolidated and consolidated.
4	Malad-lower Bear River Valley	Unconsolidated.
5	Cache Valley	Do.
6	Bear Lake Valley	Do.
7	Upper Bear River Valley	Do.
8	Ogden Valley	Do.
9	East Shore area	Do.
10	Salt Lake Valley	Do.
11	Park City area	Unconsolidated and consolidated.
12	Tooele Valley	Unconsolidated.
13	Rush Valley	Do.
14	Dugway area	Do.
	Skull Valley	Do.
	Old River Bed	Do.
15	Cedar Valley, Utah County	Do.
16	Utah and Goshen Valleys	Do.
17	Heber Valley	Do.
18	Duchesne River area	Unconsolidated and consolidated.
19	Vernal area	Do.
20	Sanpete Valley	Do.
21	Juab Valley	Unconsolidated.
22	Central Sevier Valley	Do.
23	Pahvant Valley	Unconsolidated and consolidated.
24	Sevier Desert	Unconsolidated.
25	Snake Valley	Do.
26	Milford area	Do.
27	Beaver Valley	Do.
28	Monticello area	Consolidated.
29	Spanish Valley	Unconsolidated and consolidated.
30	Blanding area	Consolidated.
31	Parowan Valley	Unconsolidated and consolidated.
32	Cedar Valley, Iron County	Unconsolidated.
33	Beryl-Enterprise area	Do.
34	Central Virgin River area	Unconsolidated and consolidated.
35	Upper Sevier Valleys	Unconsolidated.
36	Upper Fremont River Valley	Unconsolidated and consolidated.

Table 2. Number of wells constructed and estimated withdrawal of water from wells in Utah
Number of wells constructed in 1998—Data provided by Utah Department of Natural Resources, Division of Water Rights.
Estimated withdrawal from wells—
1997 total: From Susong, Burden, and others (1998, table 2).

Area	Number in figure 1	Number of wells constructed in 1998		Estimated withdrawal from wells (acre-feet)					
				1998					1997
		Total	Diameter of 12 inches or more	Irrigation	Industry	Public supply	Domestic and stock	Total (rounded)	Total (rounded)
Curlew Valley	3	2	1	29,100	0	180	100	29,000	36,000
Cache Valley	5	46	16	13,100	6,700	4,100	2,000	26,000	25,000
East Shore area	9	5	0	24,000	3,300	23,900	5,000	56,000	62,000
Salt Lake Valley	10	13	4	2,400	[1]19,500	77,900	22,000	122,000	123,000
Tooele Valley	12	36	6	[2]15,000	800	3,200	780	20,000	25,000
Utah and Goshen Valleys	16	78	16	33,200	5,800	26,700	20,200	86,000	96,000
Juab Valley	21	5	0	10,200	180	[3]1,100	400	12,000	15,000
Sevier Desert	24	9	0	5,500	3,900	1,200	1,000	12,000	17,000
Central Sevier Valley	22	[4]33	[4]2	15,700	170	2,400	2,000	20,000	20,000
Pahvant Valley	23	5	1	64,400	[5]550	550	100	66,000	67,000
Cedar Valley, Iron County	32	24	16	30,600	50	4,300	700	36,000	34,000
Parowan Valley	31	4	3	[6]27,700	120	90	250	28,000	25,000
Escalante Valley									
Milford area	26	6	6	32,700	[7]7,200	840	260	41,000	52,000
Beryl-Enterprise area	33	18	9	72,300	670	400	830	74,000	81,000
Central Virgin River area	34	2	1	2,200	70	17,900	250	20,000	18,000
Other areas[8,9]		365	51	50,500	11,600	29,700	7,300	99,000	107,000
Total (rounded)		651	132	429,000	61,000	194,000	63,000	747,000	803,000

[1] Includes some use for air conditioning, 2,960 acre-feet, of which 2,380 acre-feet was injected back into the aquifer.
[2] Includes some domestic and stock use.
[3] Includes some industrial use.
[4] Includes wells constructed in upper Sevier Valley and upper Fremont River Valley.
[5] Withdrawal for geothermal power generation. About 85 percent was injected back into the aquifer.
[6] Includes some stock use.
[7] Withdrawal for geothermal power generation. About 99 percent was injected back into the aquifer.
[8] Withdrawal totals are estimated minimum. See "Other areas" section of this report for withdrawal estimates for other areas.
[9] Includes withdrawals for upper Sevier Valley and upper Fremont River Valley that were included with central Sevier Valley in reports prior to number 31 of this series.

Table 3. Total annual withdrawal of water from wells in significant areas of ground-water development in Utah, 1988-97
[From previous reports of this series]

Area	Number in figure 1	Thousands of acre-feet										
		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1988-97 average (rounded)
Curlew Valley	3	34	29	43	37	44	35	41	31	39	36	37
Cache Valley	5	33	30	32	29	36	23	31	23	24	25	29
East Shore area	9	68	61	65	68	59	56	60	53	57	62	61
Salt Lake Valley	10	165	157	143	135	138	116	142	120	138	123	138
Tooele Valley	12	26	27	33	30	30	22	31	26	23	25	27
Utah and Goshen Valleys	16	113	121	129	124	141	89	114	77	99	96	110
Juab Valley	21	22	28	27	25	29	20	26	13	19	15	22
Sevier Desert	24	15	17	34	34	33	31	37	18	17	17	25
Central Sevier Valley[1]	22	17	18	18	18	19	19	20	20	21	20	19
Pahvant Valley	23	71	82	88	74	86	87	93	69	83	67	80
Cedar Valley, Iron County	32	20	28	30	34	34	33	34	31	35	34	31
Parowan Valley	31	20	29	31	32	31	28	30	24	29	25	28
Escalante Valley												
Milford area	26	40	46	48	54	42	50	61	48	52	52	49
Beryl-Enterprise area	33	88	85	86	79	72	78	86	70	92	81	82
Central Virgin River area	34	18	23	22	15	14	13	14	15	17	18	17
Other areas		95	100	111	111	120	94	113	97	113	107	106
Total		845	881	940	899	928	794	933	735	858	803	862

[1] Prior to 1991, included upper Sevier and upper Fremont River Valleys.

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CURLEW VALLEY

By J.D. Sory

The Curlew Valley drainage basin extends across the Utah-Idaho State line between latitude 40°41' and 42°30' north and longitude 112°30' and 113°20' west, and covers about 1,200 square miles. The valley is bounded on the west, north, and east by mountain ranges having altitudes ranging from about 6,500 to nearly 10,000 feet and is open to the south, where it drains into Great Salt Lake.

The Utah part of Curlew Valley (Utah subbasin) covers about 550 square miles. It is an arid to semiarid, largely uninhabited area, with a community center at Snowville. Average annual precipitation in the Utah subbasin is less than 8 inches on part of the valley floor and reaches a maximum that exceeds 35 inches on one of the highest mountain peaks.

The principal source of water in the Utah subbasin is the ground-water reservoir in the valley fill. Confined aquifers in alluvial and lacustrine deposits and intercalated volcanic rocks in the valley fill yield several hundred to several thousand gallons of water per minute to individual large-diameter irrigation wells west of Snowville and near Kelton.

Total estimated withdrawal of water from wells in Curlew Valley in 1998 was about 29,000 acre-feet, which is 7,000 acre-feet less than was reported for 1997 and 8,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3).

The location of wells in Curlew Valley in which the water level was measured during March 1999 is shown in figure 2. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3. Water levels generally rose from March 1998 to March 1999 in Curlew Valley. Water levels during March generally rose from 1982 to 1987, a period of much-greater-than-average precipitation, and generally declined from 1987 to 1989. The decline in water level in the northwestern part of the valley probably resulted from continued pumpage.

Precipitation at Grouse Creek during 1998 was 16.18 inches, which is 4.19 inches more than in 1997 and 4.90 inches more than the average annual precipitation for 1959-98.

The concentrations of dissolved solids in water from well (B-14-9)5bbb-1, west of Snowville, and well (B-12-11)4bcc-1, north of Kelton, generally have increased since 1972. These increases may be a result of recharge from unconsumed irrigation water in which dissolved solids are concentrated by evaporation.

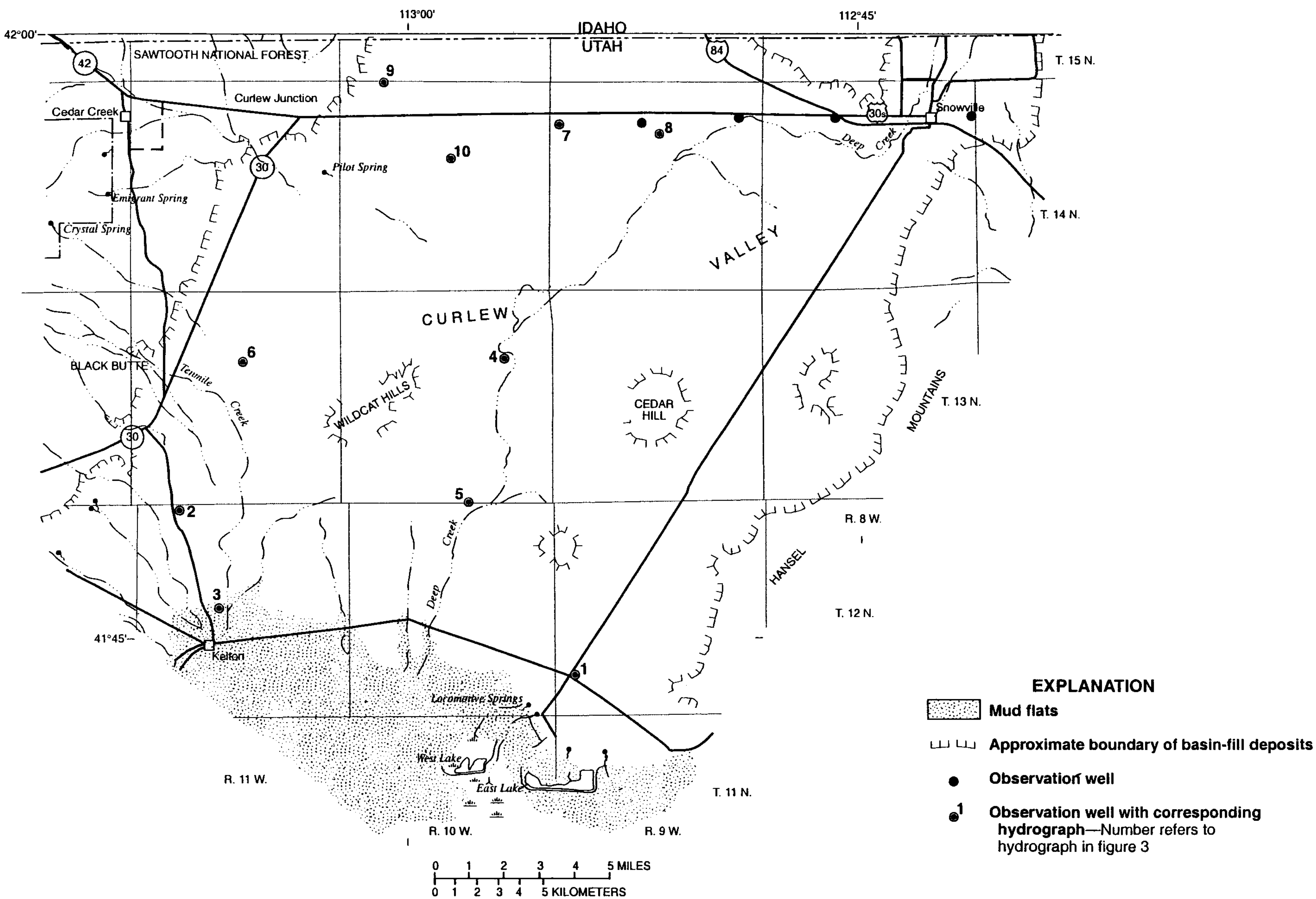


Figure 2. Location of wells in Curlew Valley in which the water level was measured during March 1999.

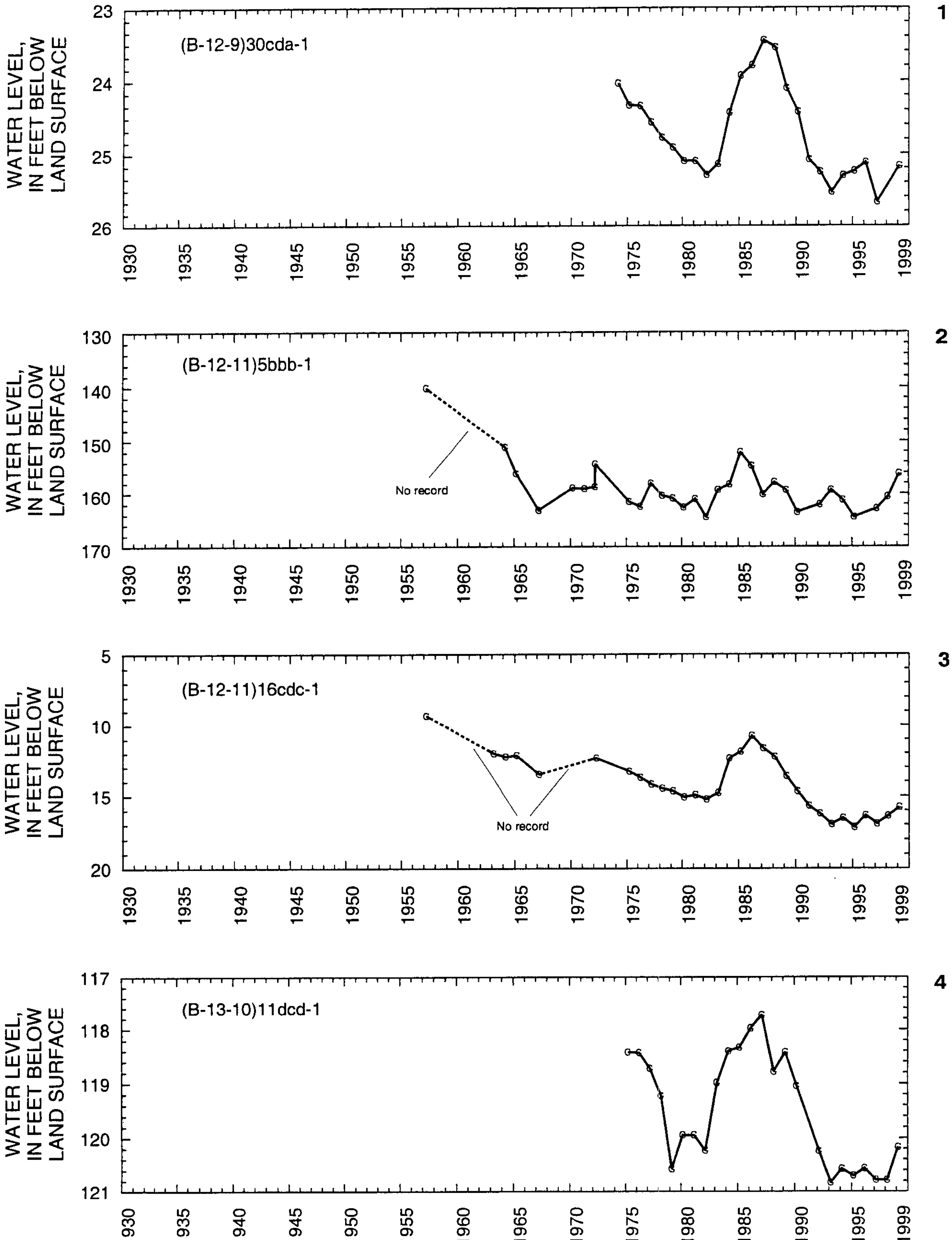


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

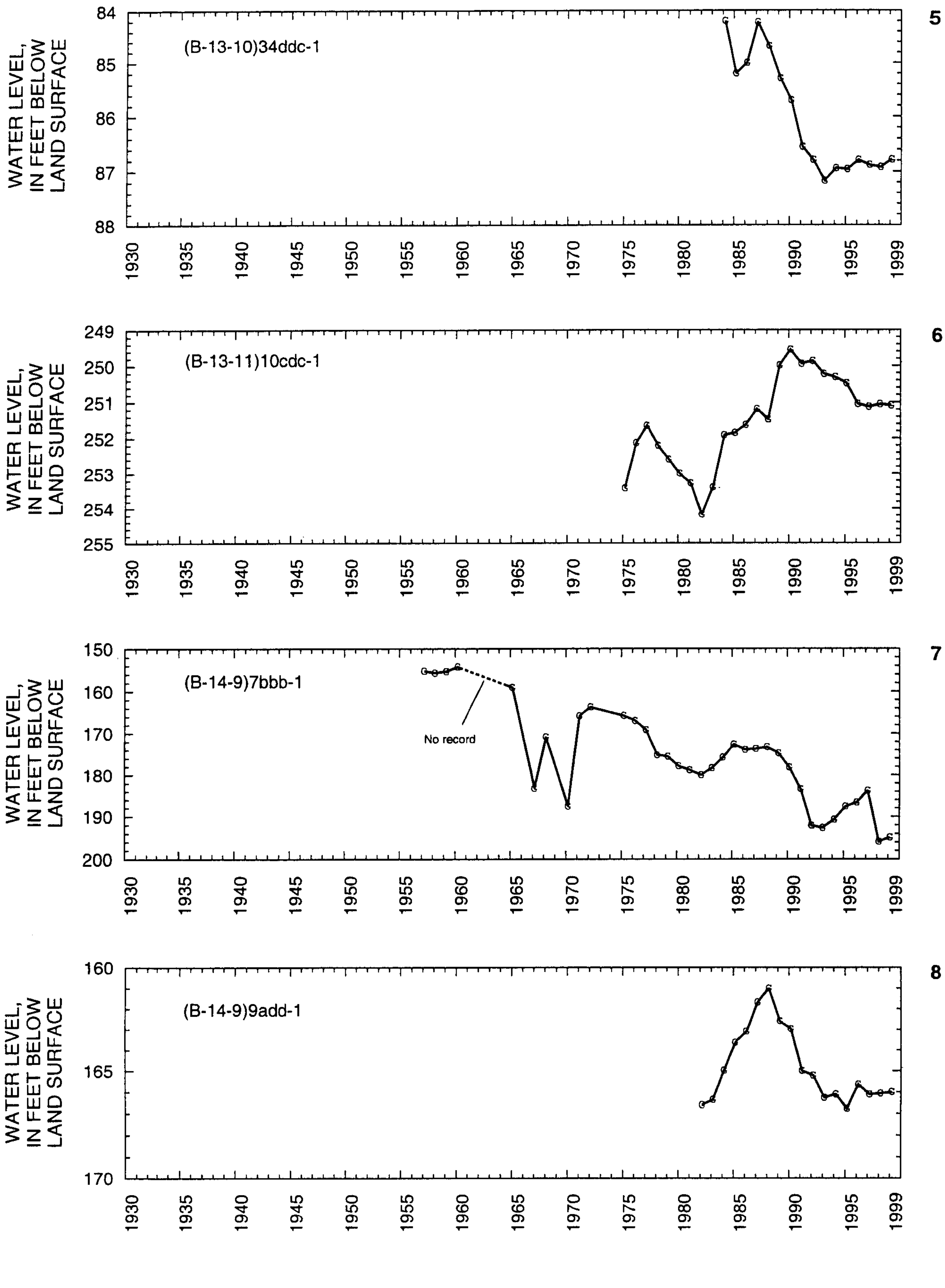
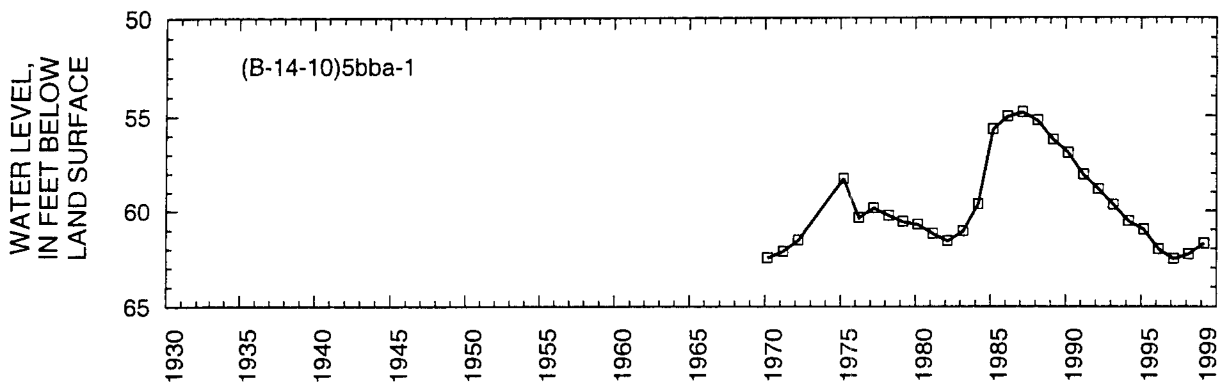


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells —Continued.



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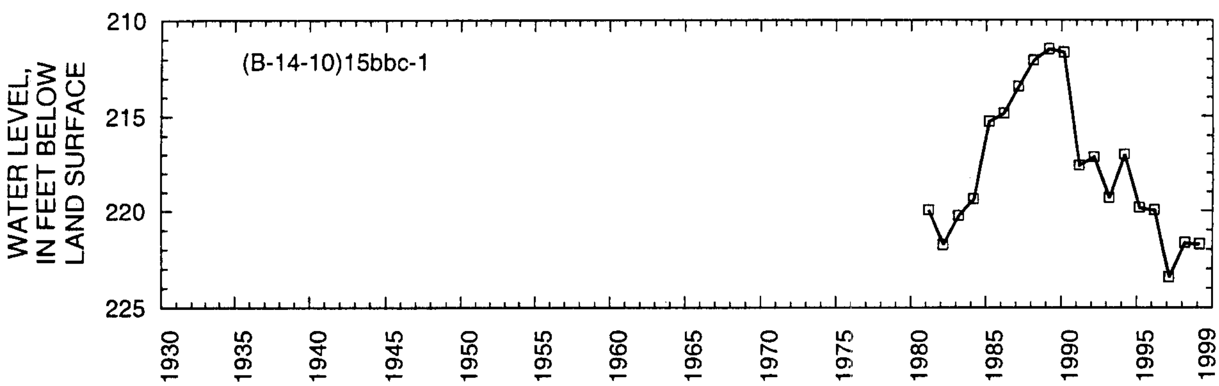

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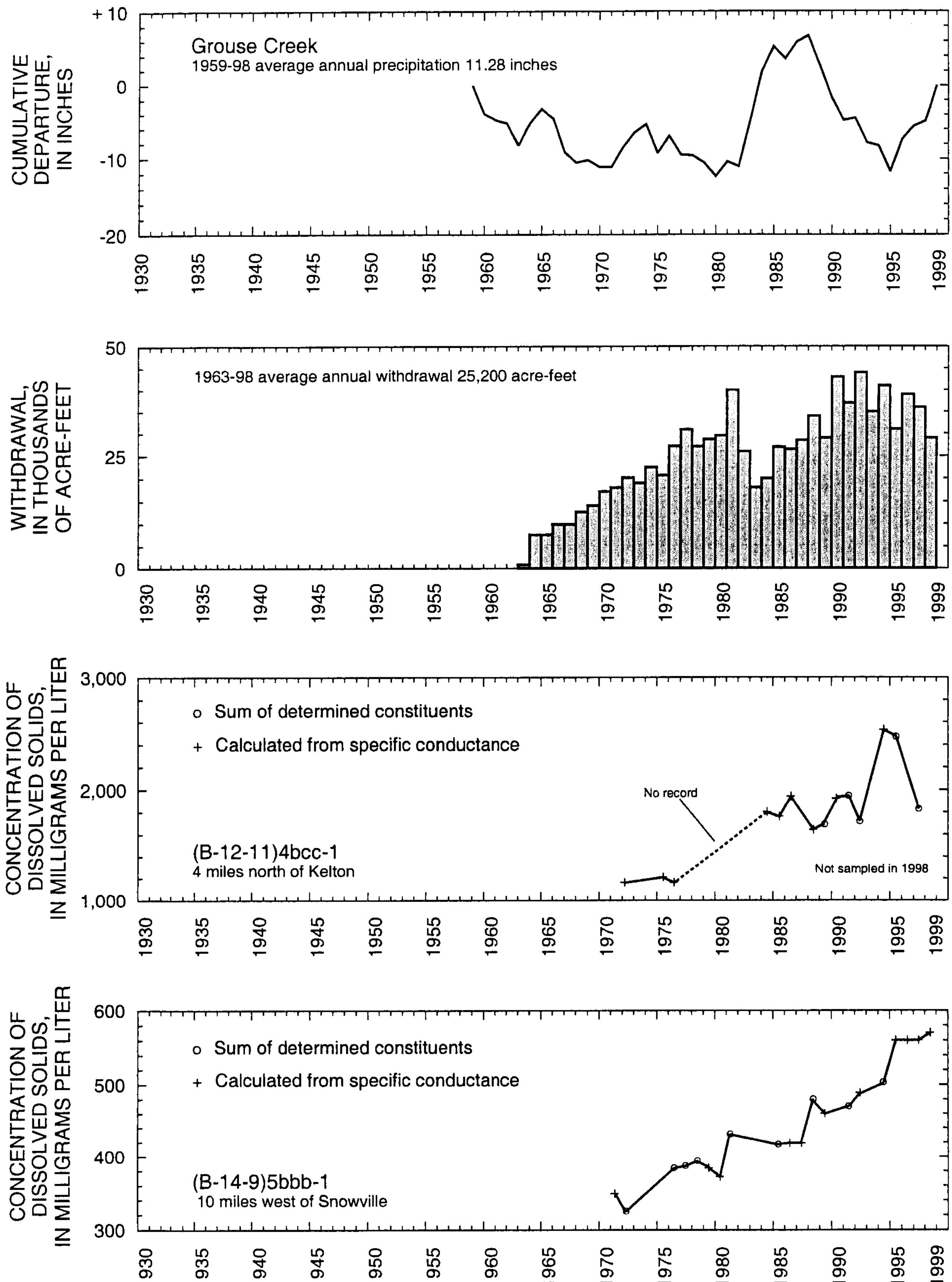


Figure 3. Relation of water level in selected wells in Curlew Valley to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

CACHE VALLEY

By R. J. Eacret

Cache Valley, as referred to in this report, covers about 450 square miles in Utah. Ground water occurs in unconsolidated deposits in the valley, under both water-table and artesian conditions. Recharge to the ground-water system occurs principally along the sides of the valley, and ground water moves toward the center of the valley and toward a point of discharge near Cache Junction.

Total estimated withdrawal of water from wells in Cache Valley in 1998 was about 26,000 acre-feet, which is about 1,000 acre-feet more than was reported for 1997 and 3,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3). The increase in withdrawals mostly resulted from increases in public supply and industrial use.

The location of wells in Cache Valley in which the water level was measured during March 1999 is shown in figure 4. The relation of the water level in selected wells to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1 is shown in figure 5. Hydrographs of water levels measured in March from six wells show a general rise and water levels in two wells declined in Cache Valley from 1998 to 1999. Water levels in March generally rose from about 1980 to 1985, corresponding to a period of greater-than-average precipitation, generally declined from 1985 to 1990, and generally have risen or remained stable since 1990. Water-level rises since 1990 probably resulted from greater-than-average precipitation in 5 of the last 7 years.

Total discharge of the Logan River (combined flow from the Logan River above State Dam, near Logan, and Logan, Hyde Park, and Smithfield Canal at Head, near Logan) during 1998 was about 270,700 acre-feet, which is 3,100 acre-feet less than the revised 273,800 acre-feet of discharge during 1997 and 147 percent of the 1941-98 average annual discharge.

Precipitation at Logan, Utah State University, was 27.36 inches in 1998. This is 5.04 inches more than the precipitation reported for 1997 and 8.51 inches more than the average annual precipitation for 1941-98. The concentration of dissolved solids in water from well (A-13-1)29bcd-1 fluctuated during 1970-98 with no apparent trend.

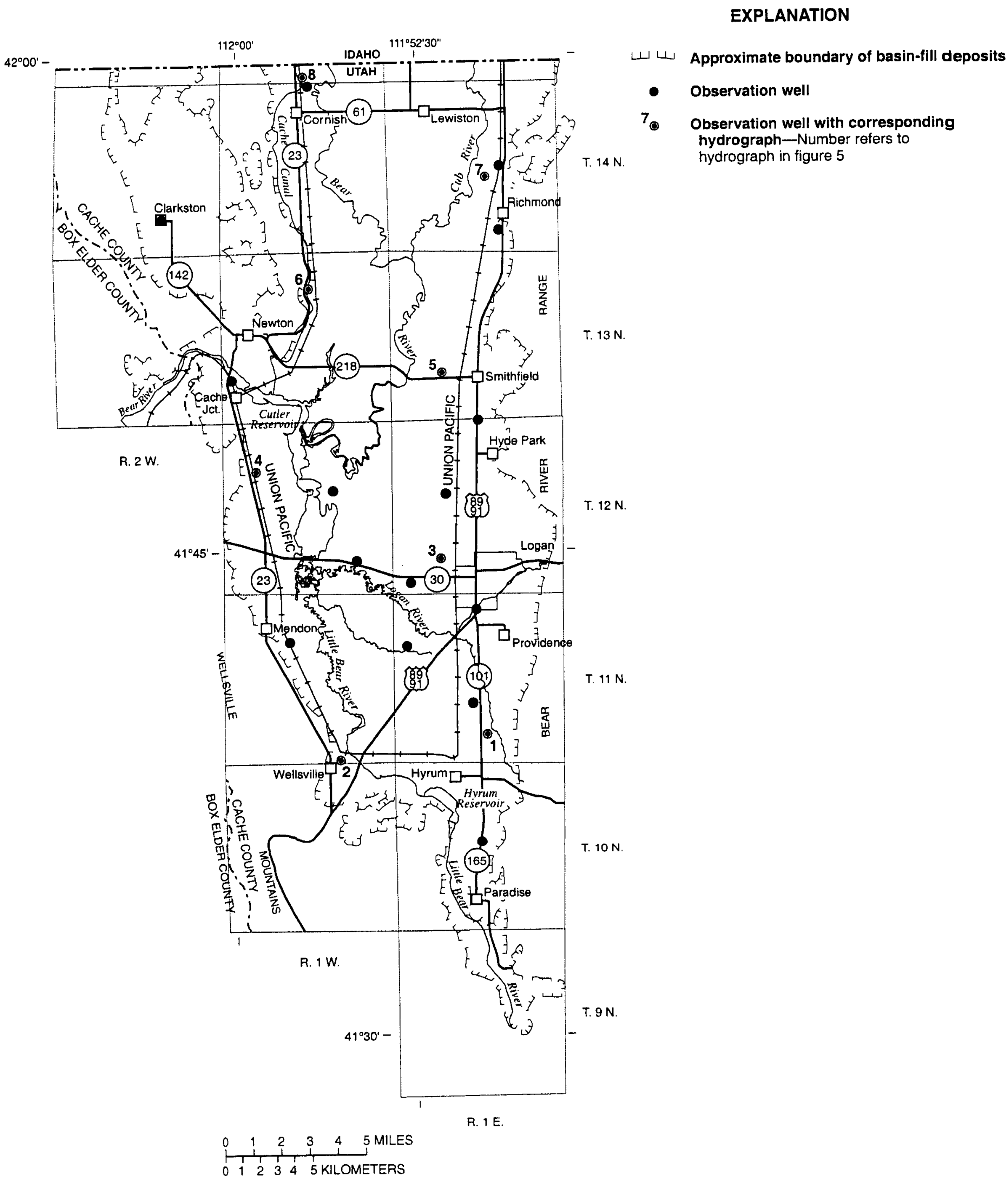


Figure 4. Location of wells in Cache Valley in which the water level was measured during March 1999.

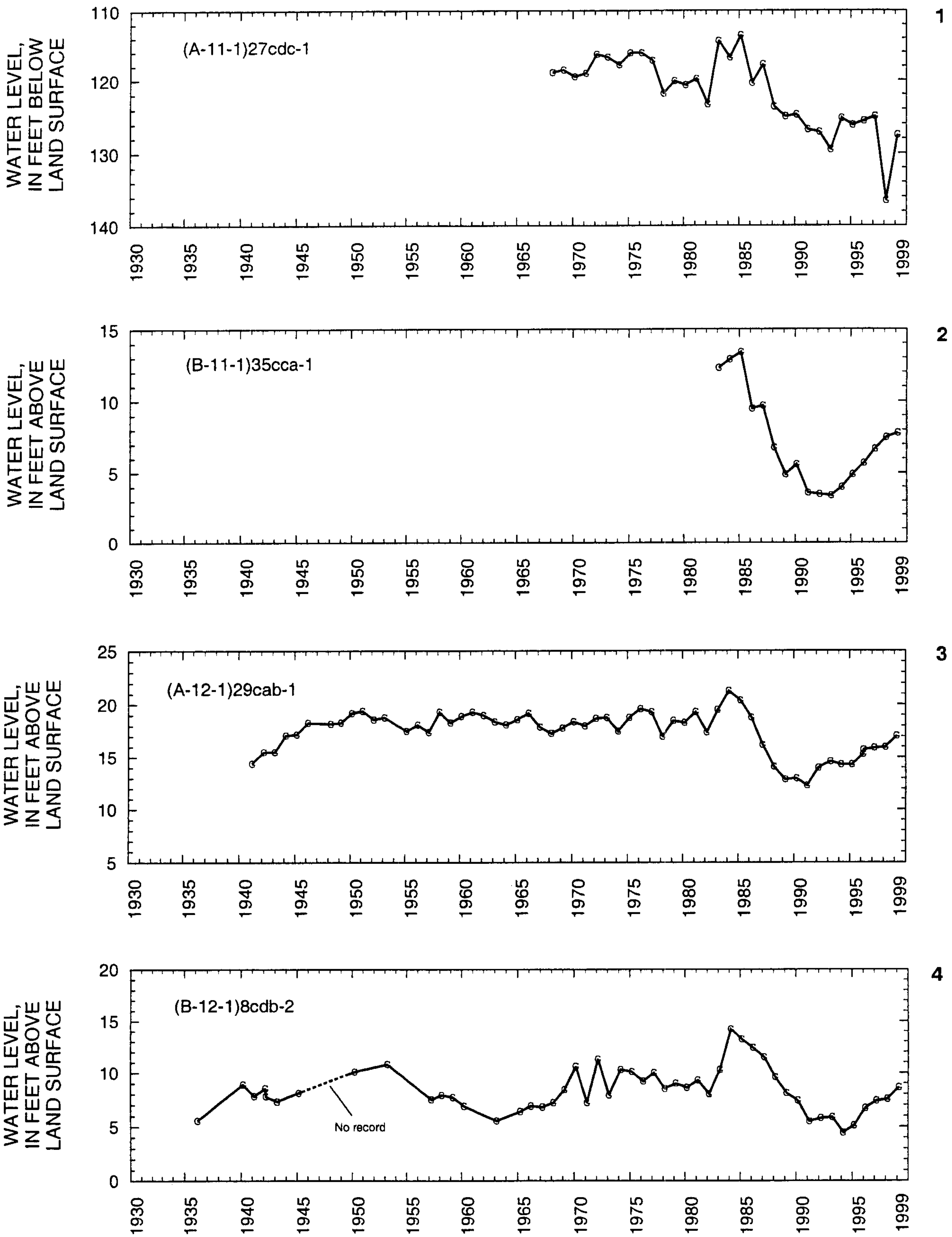
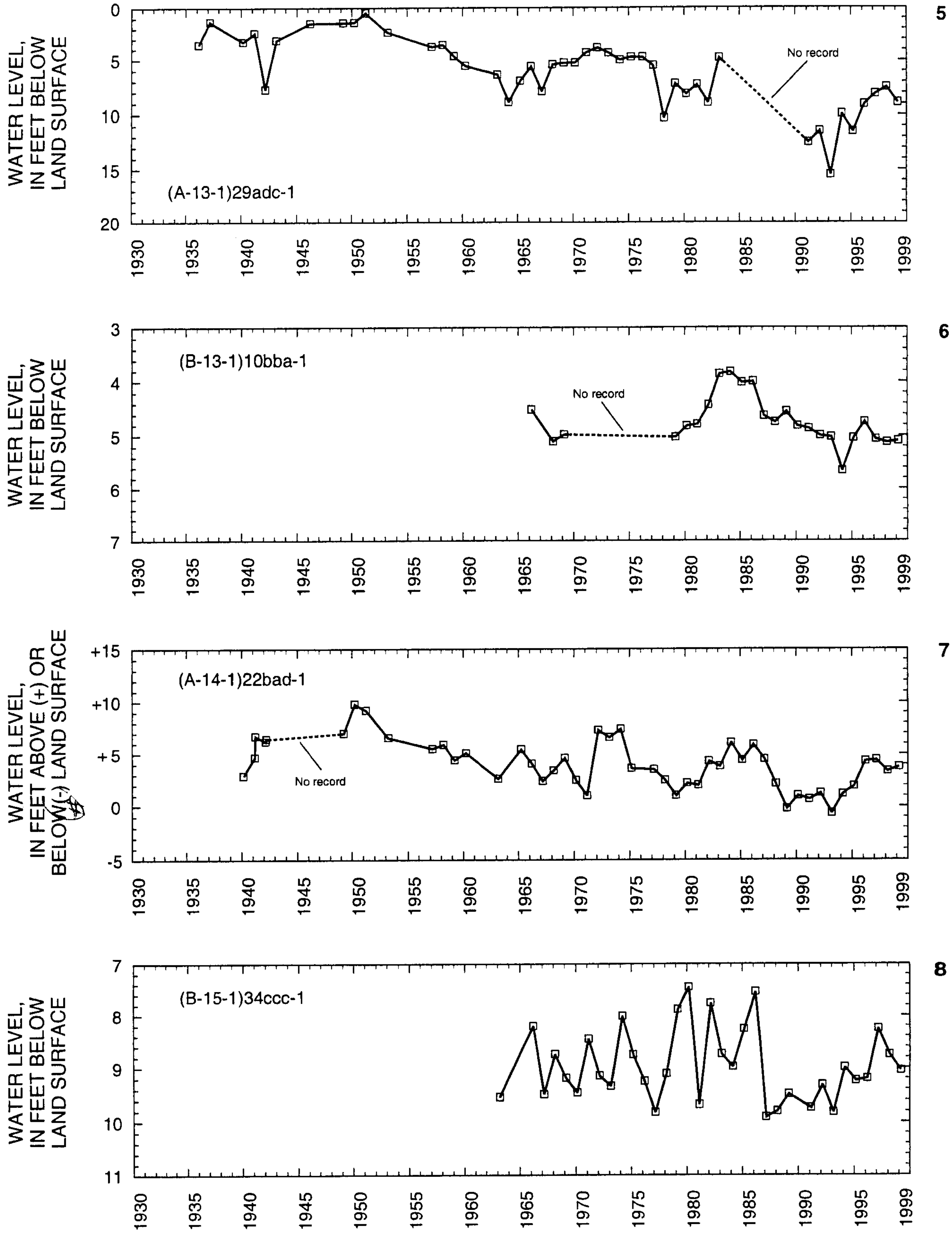


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1.



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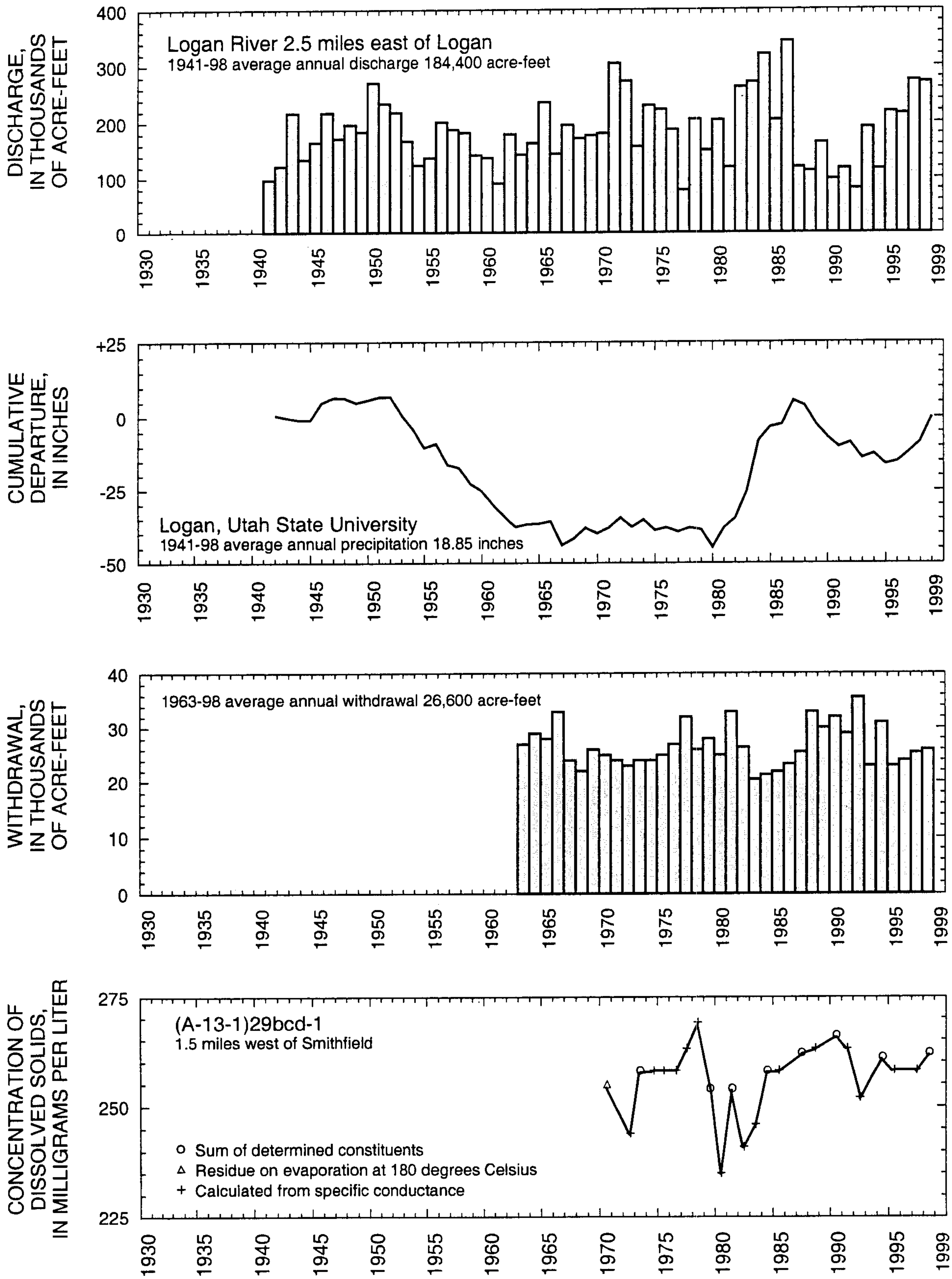


Figure 5. Relation of water level in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from average annual precipitation at Logan, Utah State University, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (A-13-1)29bcd-1—Continued.

EAST SHORE AREA

By T.A. Kenney

The East Shore area is in north-central Utah between the Wasatch Range and Great Salt Lake. Ground water occurs in unconsolidated deposits under both water-table and artesian conditions, but most of the water is withdrawn by wells from the artesian aquifers. Water enters the artesian aquifers along the east edge of the Weber Delta and Bountiful area and generally moves westward toward Great Salt Lake.

Total estimated withdrawal of water from wells in the East Shore area in 1998 was about 56,000 acre-feet, which is 6,000 acre-feet less than was reported for 1997 and 5,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3). The decrease in withdrawals mostly resulted from decreased withdrawals for public supply. Withdrawal for public supply was about 23,900 acre-feet, which is about 3,700 acre-feet less than in 1997. Industrial withdrawal decreased by about 300 acre-feet to 3,300 acre-feet, and irrigation withdrawal decreased by about 1,300 acre-feet to 24,000 acre-feet from 1997 to 1998.

The location of wells in the East Shore area in which the water level was measured during March 1999 is shown in figure 6. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at the Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 is shown in figure 7. Water levels in March in the southern part of the East Shore area generally declined from 1984 to 1989 and generally have risen since 1989. Water levels in the western part of the East Shore area generally have declined since the 1950s. Declines probably resulted from continued large withdrawal for public supply. Precipitation at the Ogden Pioneer Powerhouse in 1998 was 29.72 inches, which is 7.81 inches more than the average annual precipitation for 1937-98, and 5.17 inches more than in 1997.

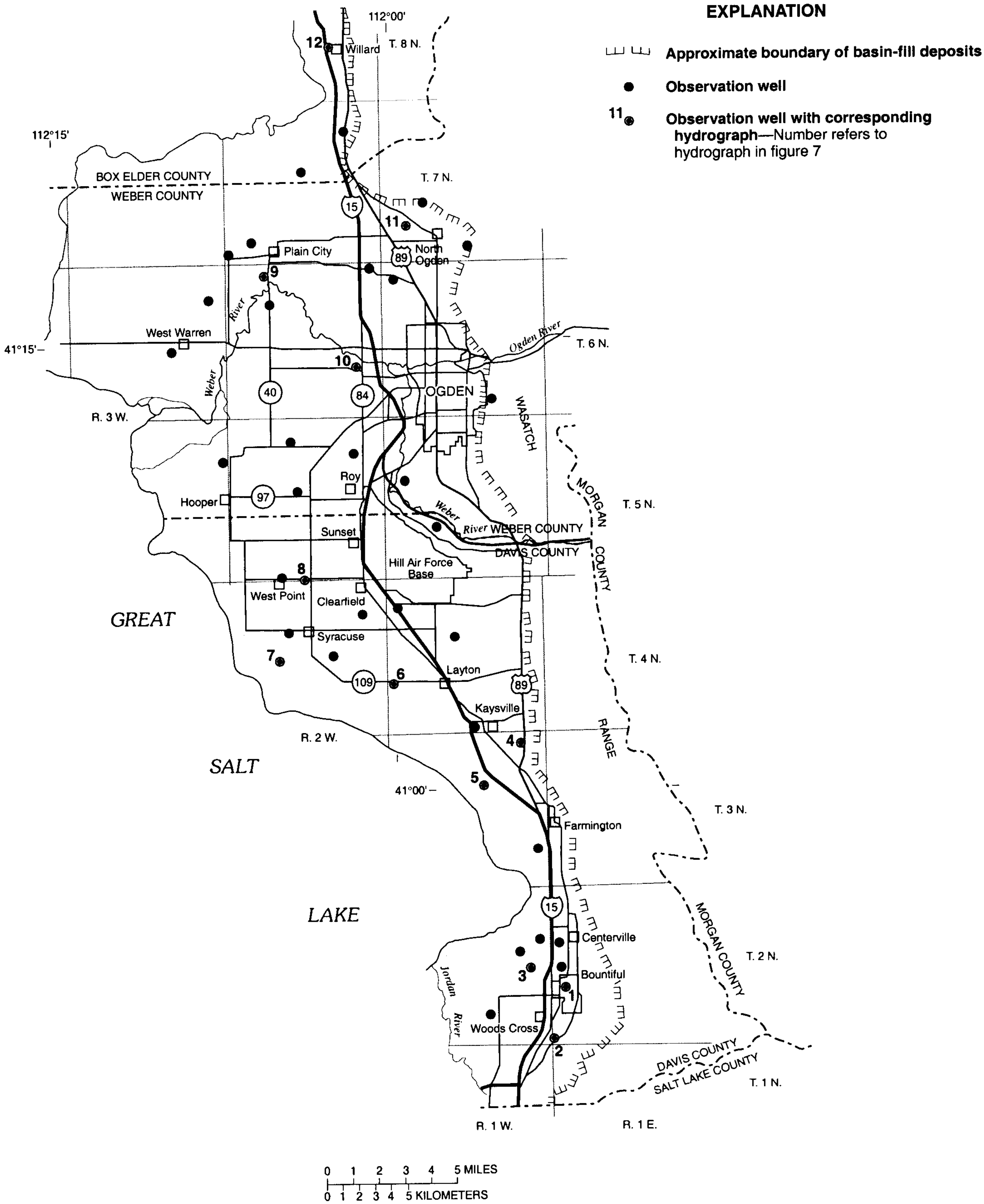


Figure 6. Location of wells in the East Shore area in which the water level was measured during March 1999.

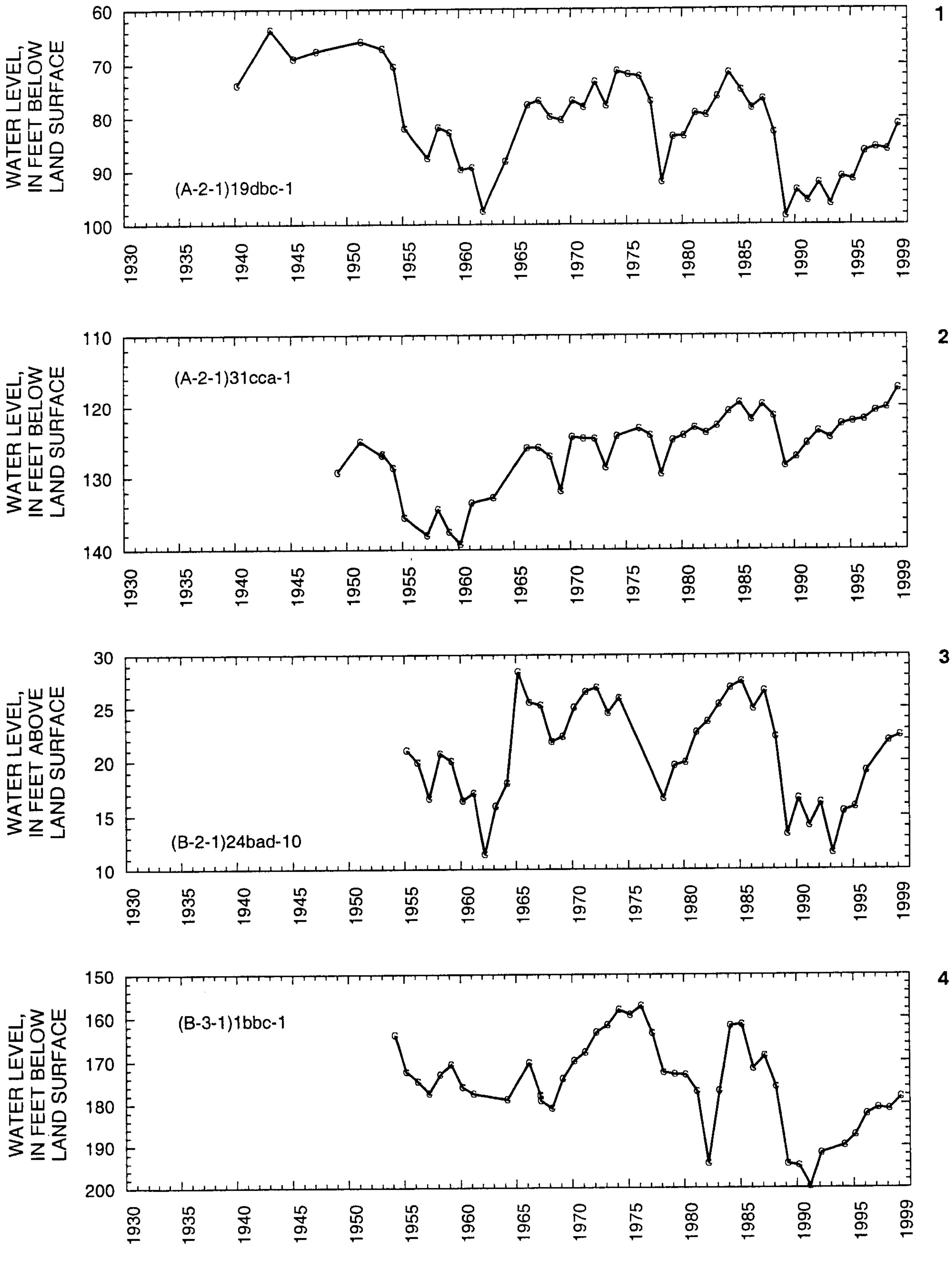


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

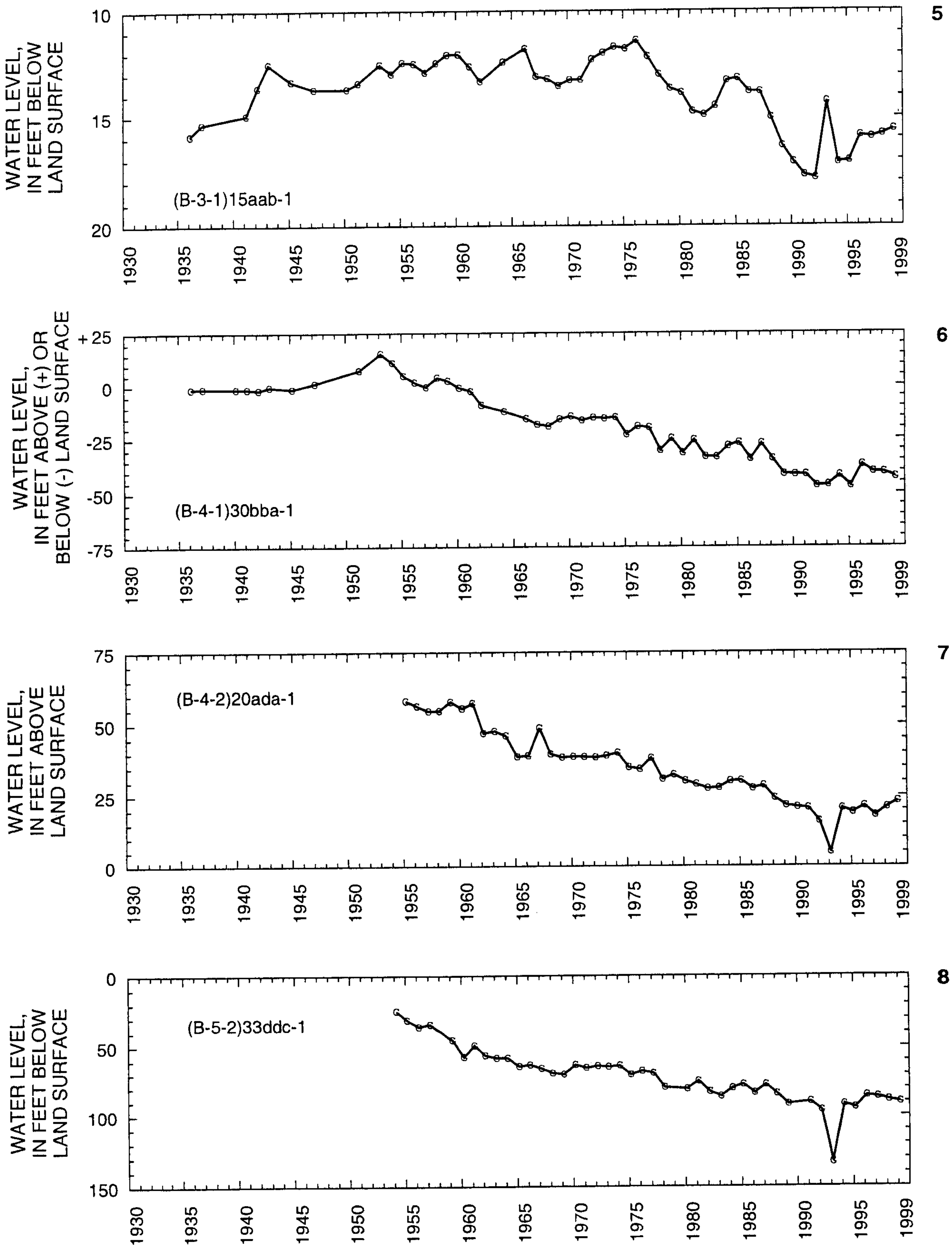


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.

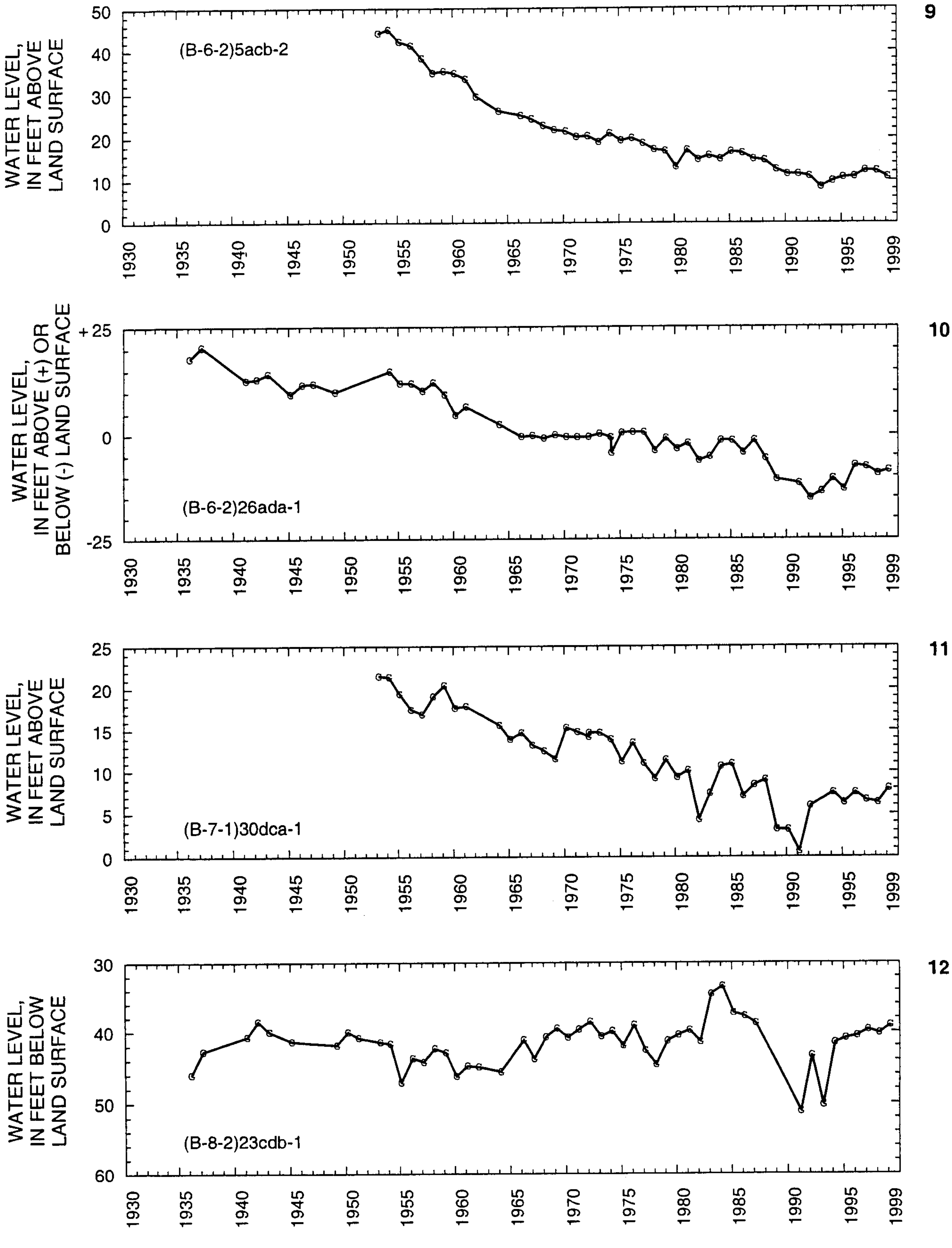


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.

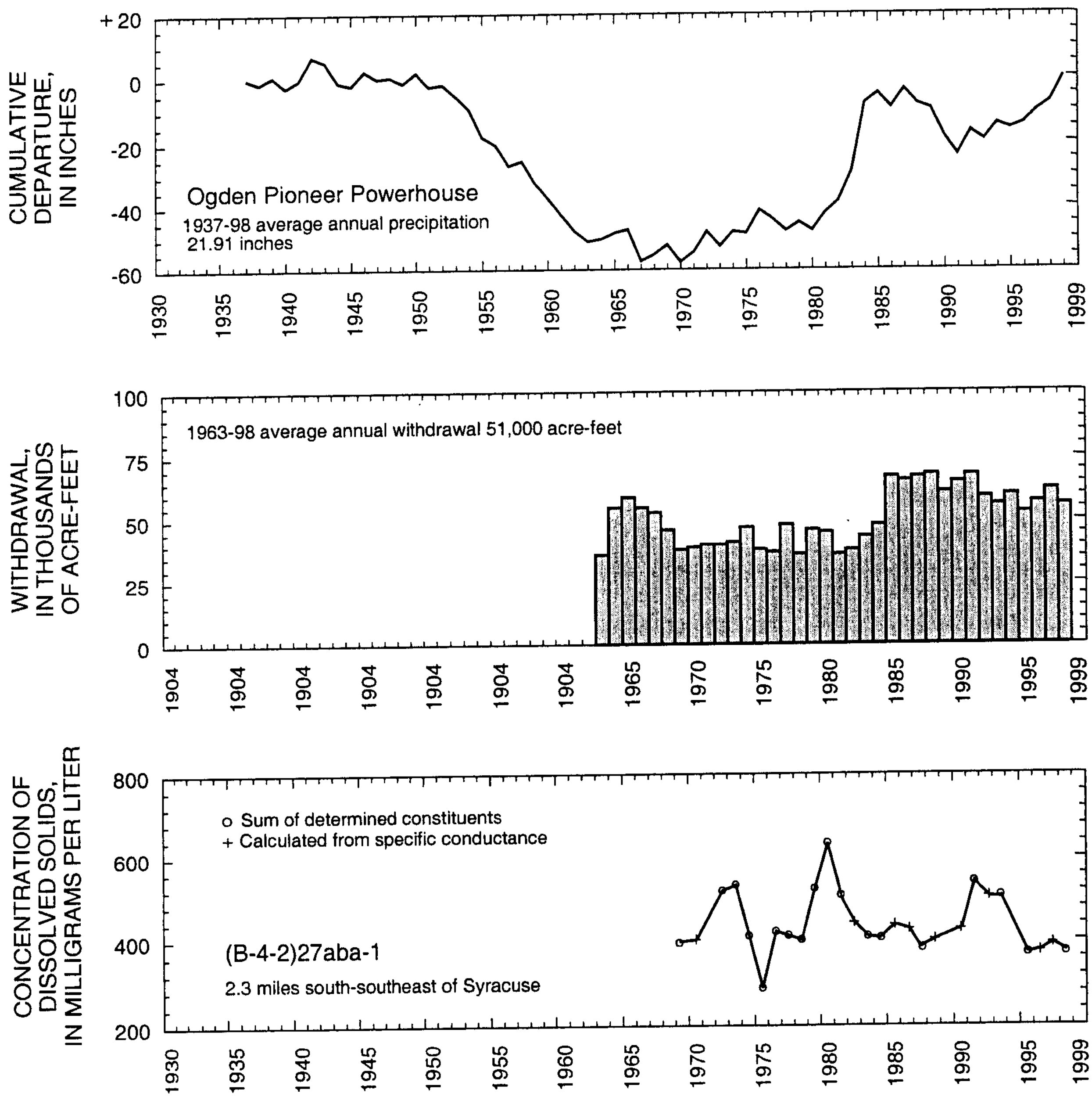


Figure 7. Relation of water level in selected wells in the East Shore area to cumulative departure from average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.

SALT LAKE VALLEY

By K.K. Johnson

Salt Lake Valley covers about 400 square miles in the lowlands of Salt Lake County. Ground water occurs in unconsolidated deposits in the valley under water-table and artesian conditions. Recharge to the aquifers is from the mountains that border the valley. In the southern two-thirds of the western half of the valley, ground water moves from the base of the Oquirrh Mountains eastward toward the Jordan River; in the northern one-third of the western half of the valley, the direction of movement is mostly toward Great Salt Lake. In the eastern half of the valley, ground water moves westward from the base of the Wasatch Range toward the Jordan River. The Jordan River drains both surface water and ground water from the valley.

Total estimated withdrawal of water from wells in Salt Lake Valley in 1998 was about 122,000 acre-feet, which is 1,000 acre-feet less than in 1997 and about 16,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3). Withdrawal for public supply was about 77,900 acre-feet, which is 1,400 acre-feet more than was reported in 1997. Withdrawal for industrial use was about 19,500 acre-feet, which is 2,500 acre-feet less than was reported for 1997.

The location of wells in Salt Lake Valley in which the water level was measured during February 1999 is shown in figure 8. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at the Salt Lake City Weather Service Office (WSO) (International Airport) are shown in figure 9. Precipitation at the Salt Lake City WSO during 1998 was 23.81 inches, 8.49 inches more than the average annual precipitation for 1931-98.

The relation of the water level in selected wells completed in the principal aquifer to cumulative departure from average annual precipitation at Silver Lake near Brighton, and the relation of the water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well are shown in figure 10. Precipitation at Silver Lake near Brighton was 49.81 inches in 1998, which is 6.93 inches more than the average annual precipitation for 1931-98 and 7.09 inches more than in 1997. The water level in 5 of 14 selected observation wells in the principal aquifer of the Salt Lake Valley was lower in February 1999 than it was in February 1998; the water level in 8 wells was higher; and the water level in 1 well showed no change. The water level in most of the observation wells was highest during 1985-87, which corresponds to a period of much-greater-than-average precipitation during 1982-86. The water level in most of the observation wells was lowest during 1990-93, which corresponds to a drier period during 1987-92.

Water levels in observation wells in the southeastern part of the valley show long-term effects from large withdrawals. The water level in well (C-2-1)24adc-1 has declined about 24 feet since 1940, although in February 1999 it was 4.6 feet above its all-time low in 1992.

The chloride concentration from well (D-1-1) 7abd-6 (located in Artesian Well Park in Salt Lake City) was 140 milligrams per liter in July 1998; this is the highest measured concentration for this well on record. The chloride concentration has continued to increase since the 1960s.

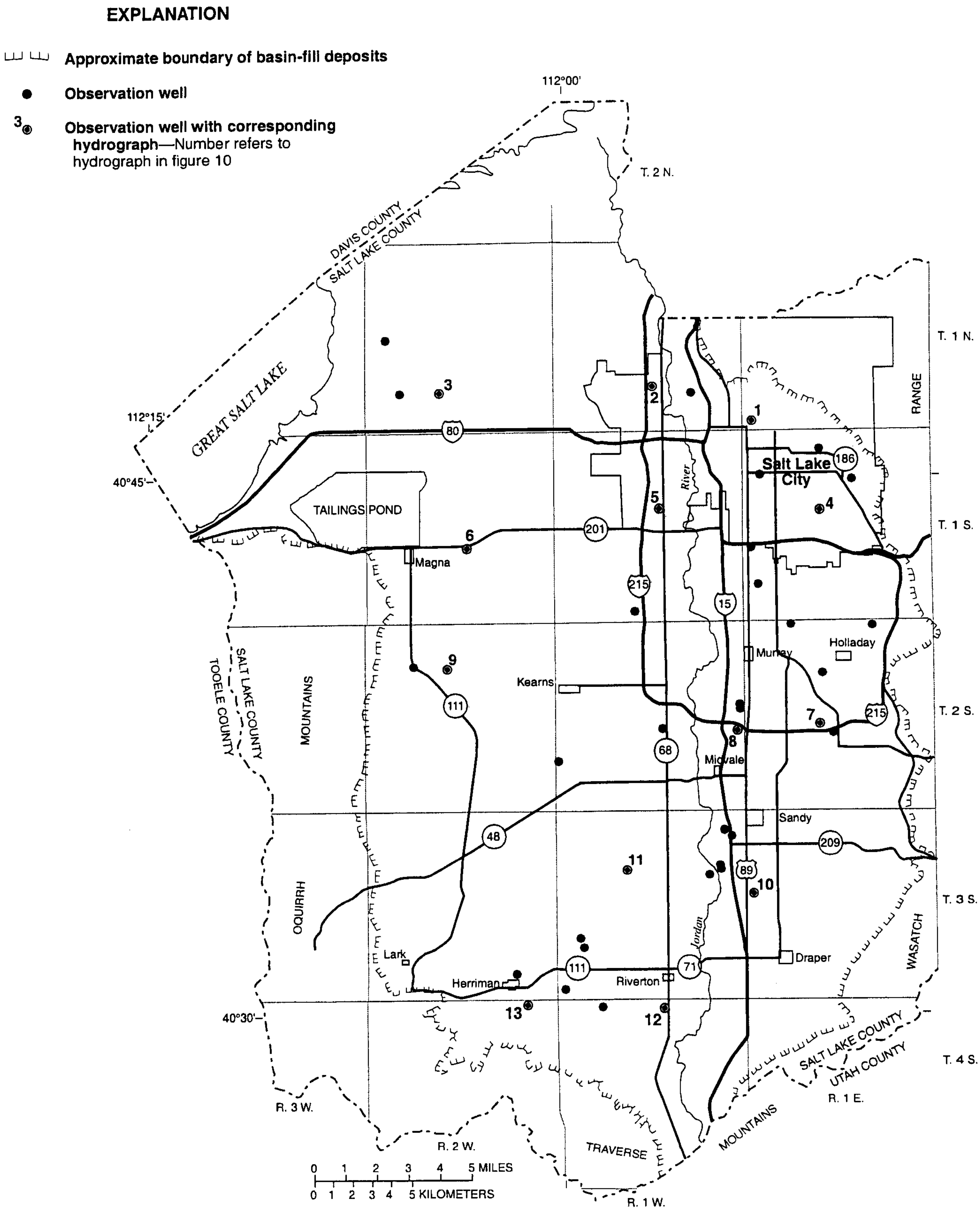


Figure 8. Location of wells in Salt Lake Valley in which the water level was measured during February 1999.

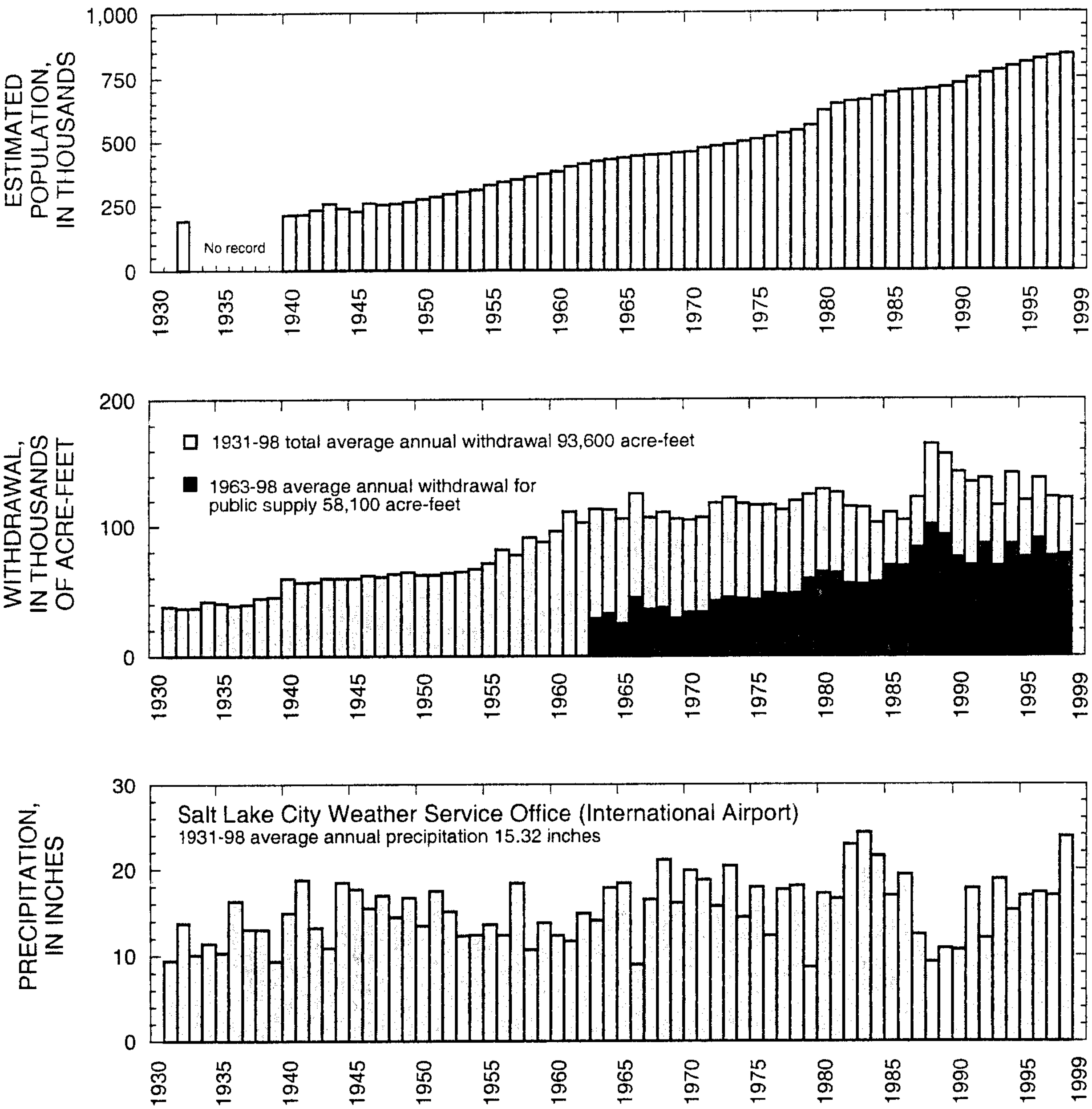


Figure 9. Estimated population of Salt Lake County, total annual withdrawal from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City Weather Service Office (International Airport).

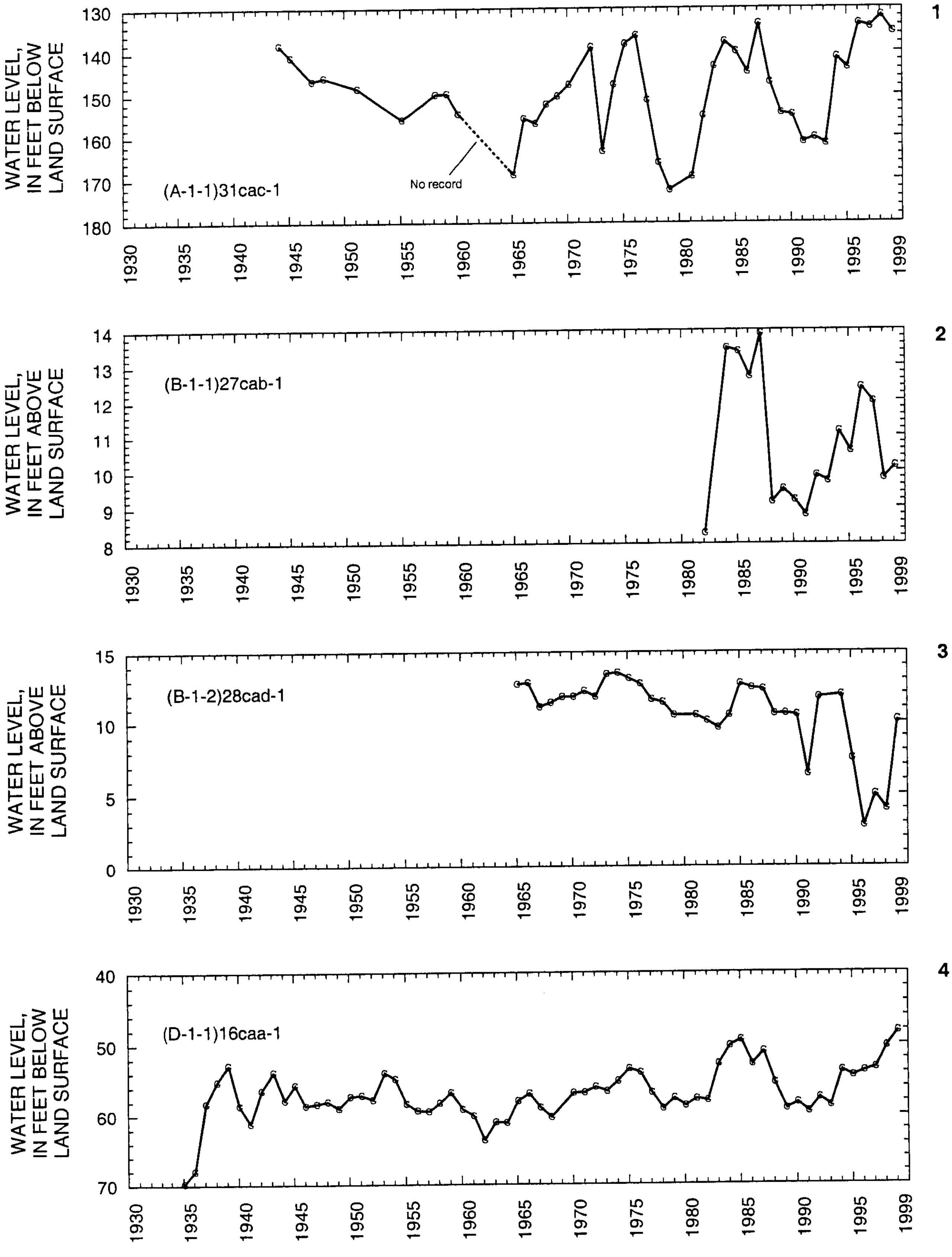


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.

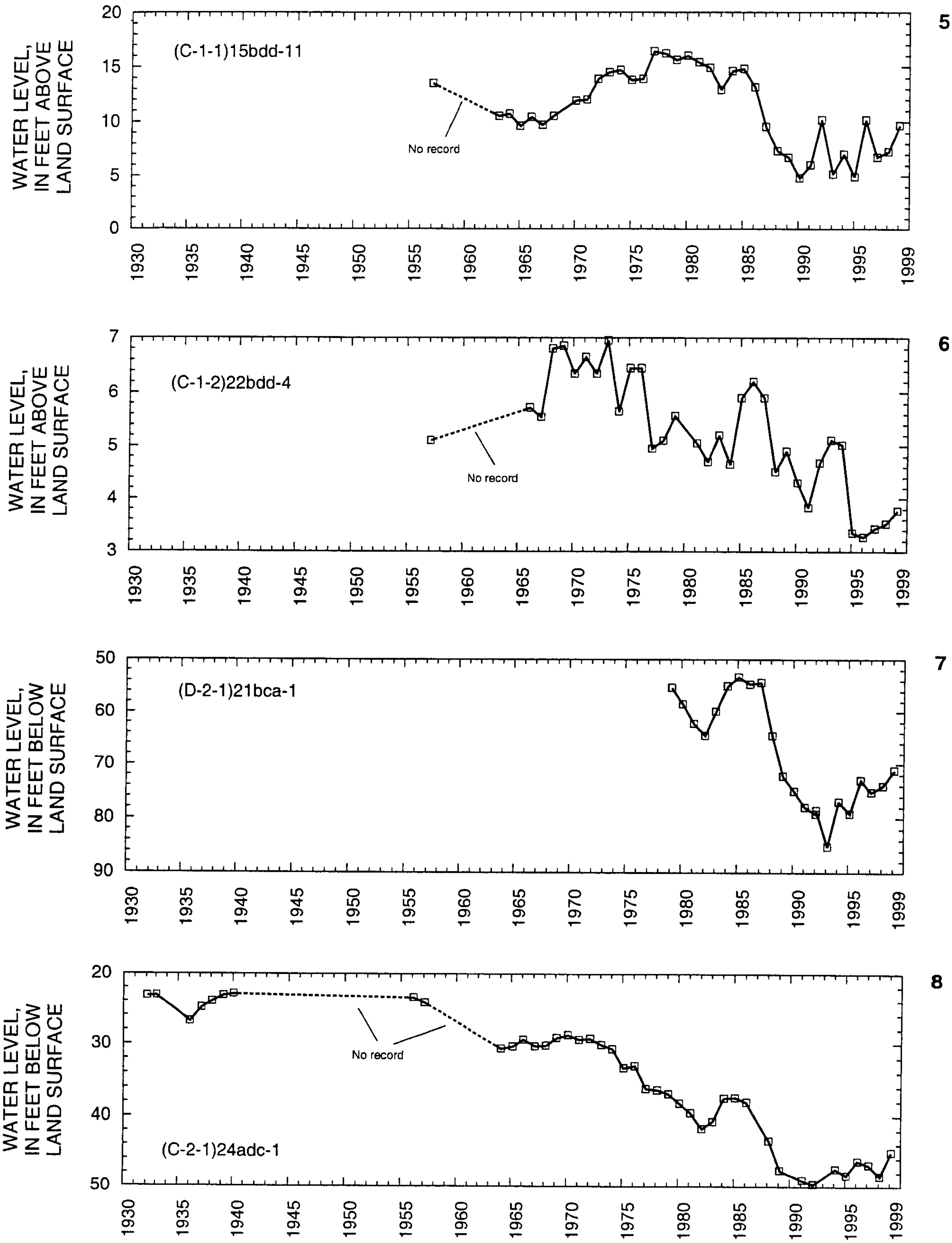


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.

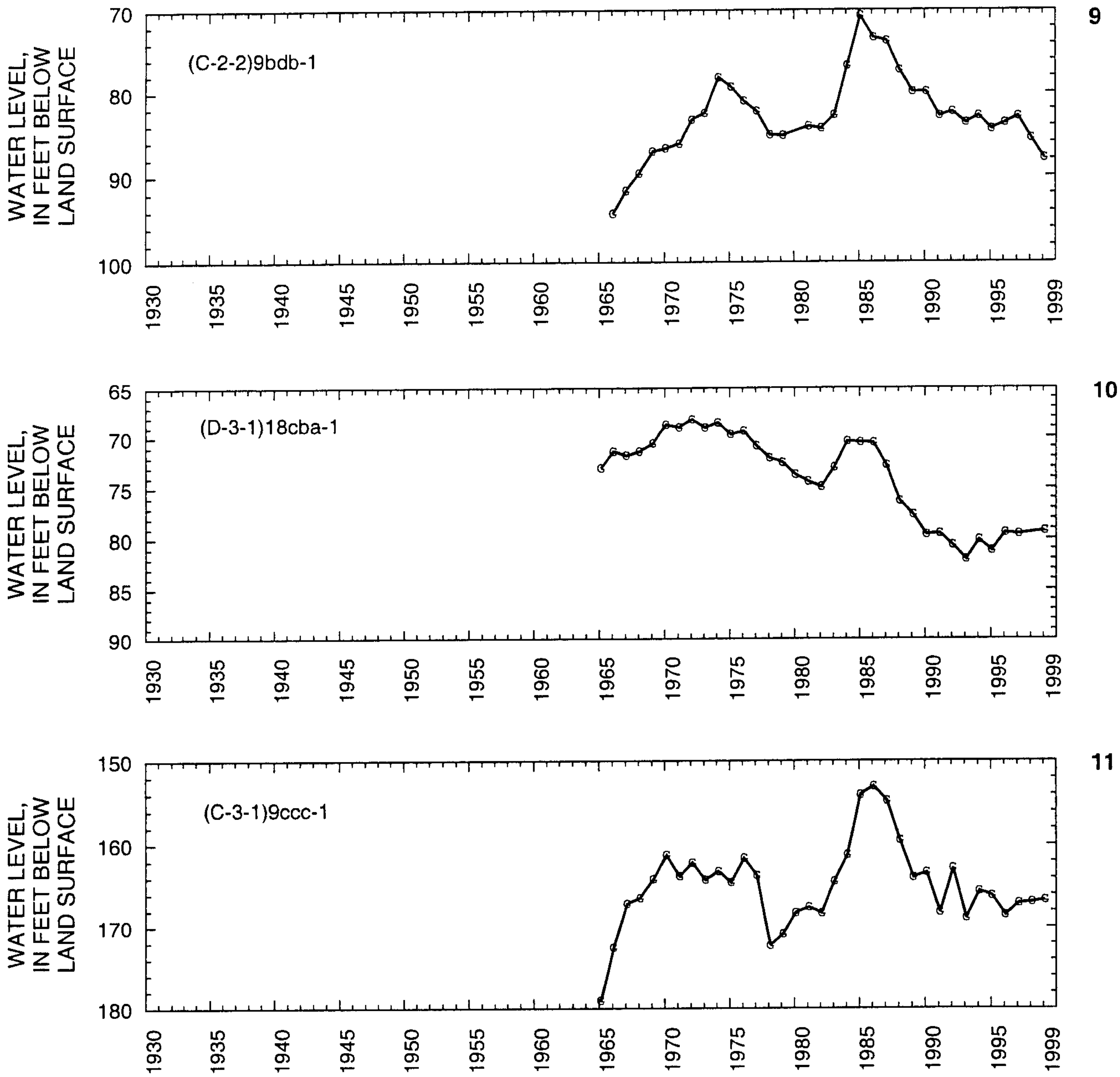


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.

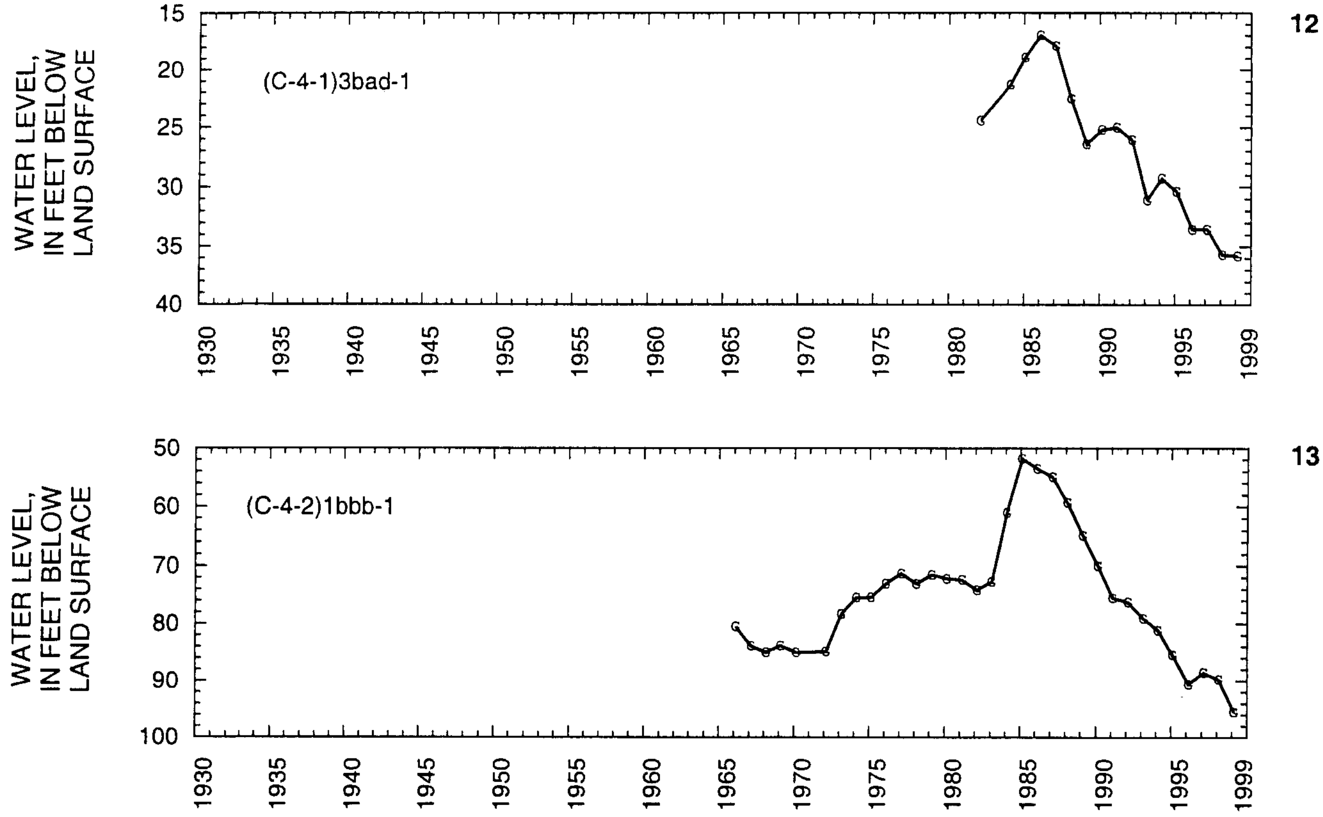


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.

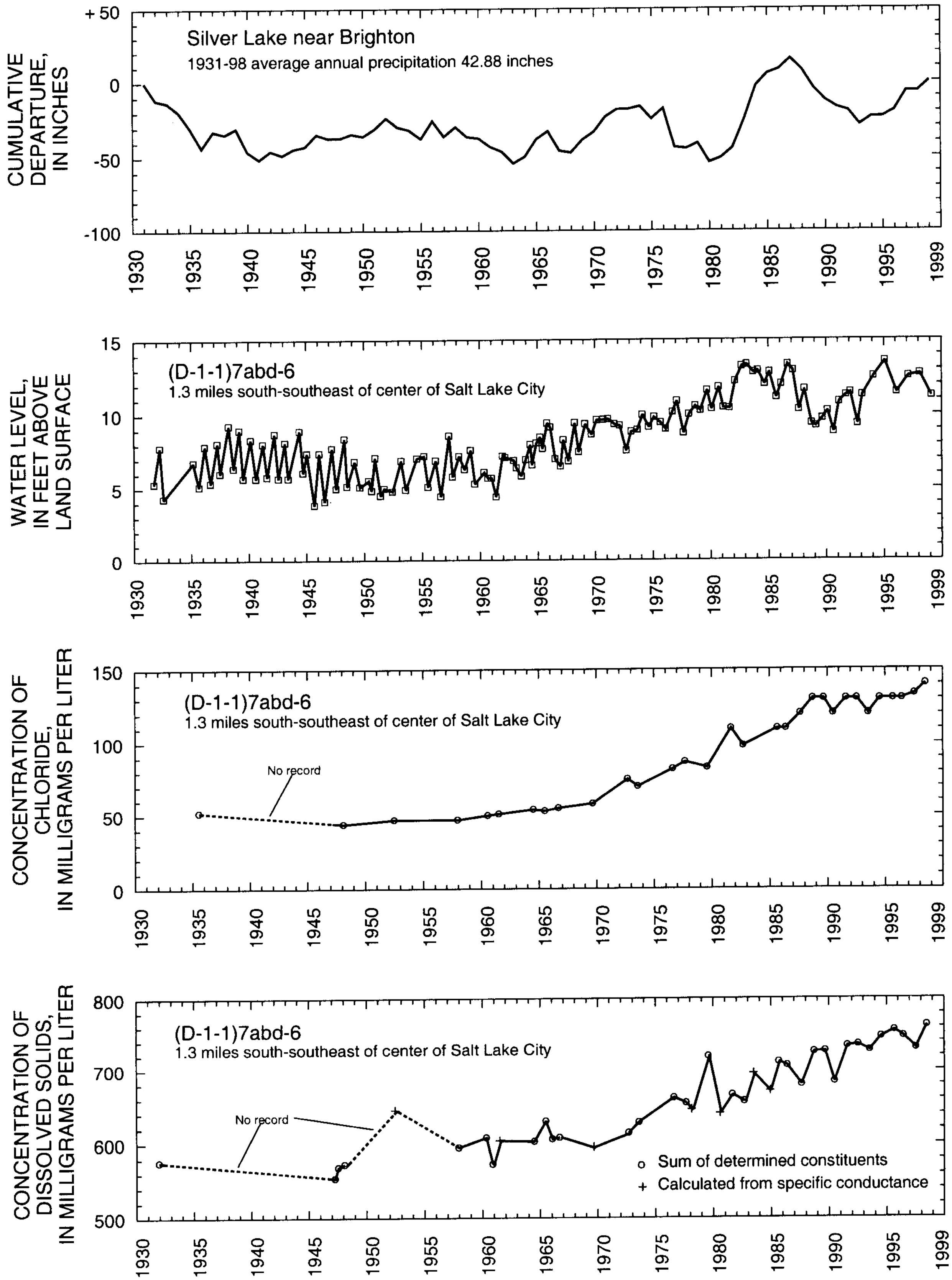


Figure 10. Relation of water level in selected wells completed in the principal aquifer in Salt Lake Valley to cumulative departure from average annual precipitation at Silver Lake near Brighton, and relation of water level in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.

TOOELE VALLEY

By B.L. Loving

Tooele Valley is between the Stansbury Mountains and Oquirrh Mountains and extends from Great Salt Lake to a low ridge called South Mountain. The total area of the valley is about 250 square miles.

Ground water occurs in the unconsolidated deposits in Tooele Valley under both water-table and artesian conditions, but nearly all the water withdrawn by wells is from artesian aquifers.

Total estimated withdrawal of water from wells in Tooele Valley in 1998 was about 20,000 acre-feet, which is 5,000 acre-feet less than was reported for 1997 and is 7,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3). The decline in withdrawals resulted from another year of greater-than-average precipitation, with declines in all categories. Withdrawal for public supply was about 3,200 acre-feet, which is 500 acre-feet less than was reported for 1997. Withdrawal for irrigation use in 1998 was about 15,000 acre-feet, which is 4,900 acre-feet less than was reported for 1997.

The location of wells in Tooele Valley in which the water level was measured during March 1999 is shown in figure 11. The relation of the water level in selected wells to cumulative departure from average annual precipitation at Tooele and to annual withdrawal from wells is shown in figure 12. Precipitation during 1998 at Tooele was 26.69 inches, 0.24 inch less than in 1997 and 8.81 inches more than the average annual precipitation for 1936-98.

The water level in the selected observation wells in the principal aquifer of Tooele Valley generally was higher in March 1998 than in March 1997. Water levels generally have continued to rise during the last 5 years as a result of greater-than-average precipitation.

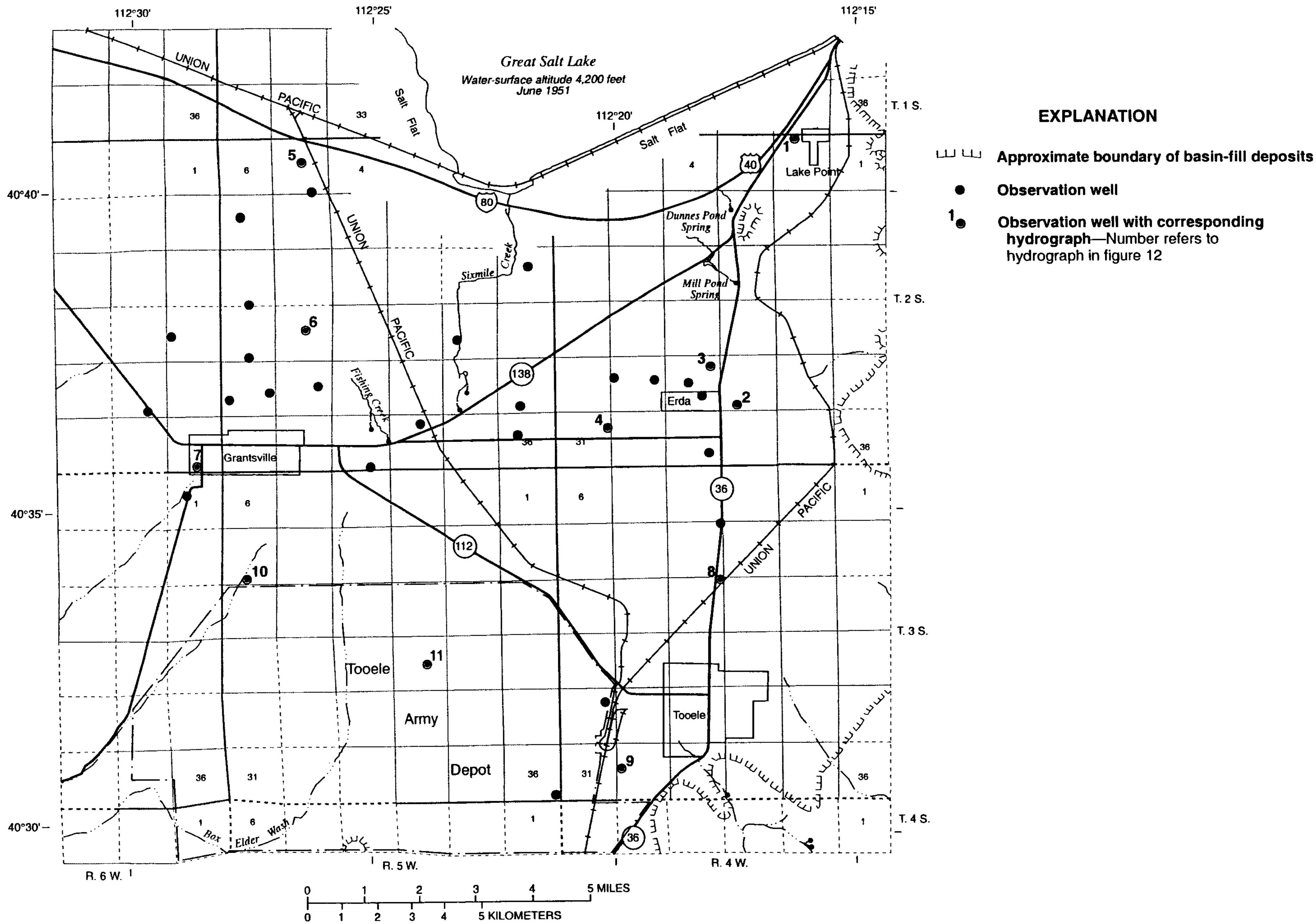


Figure 11. Location of wells in Tooele Valley in which the water level was measured during March 1999.

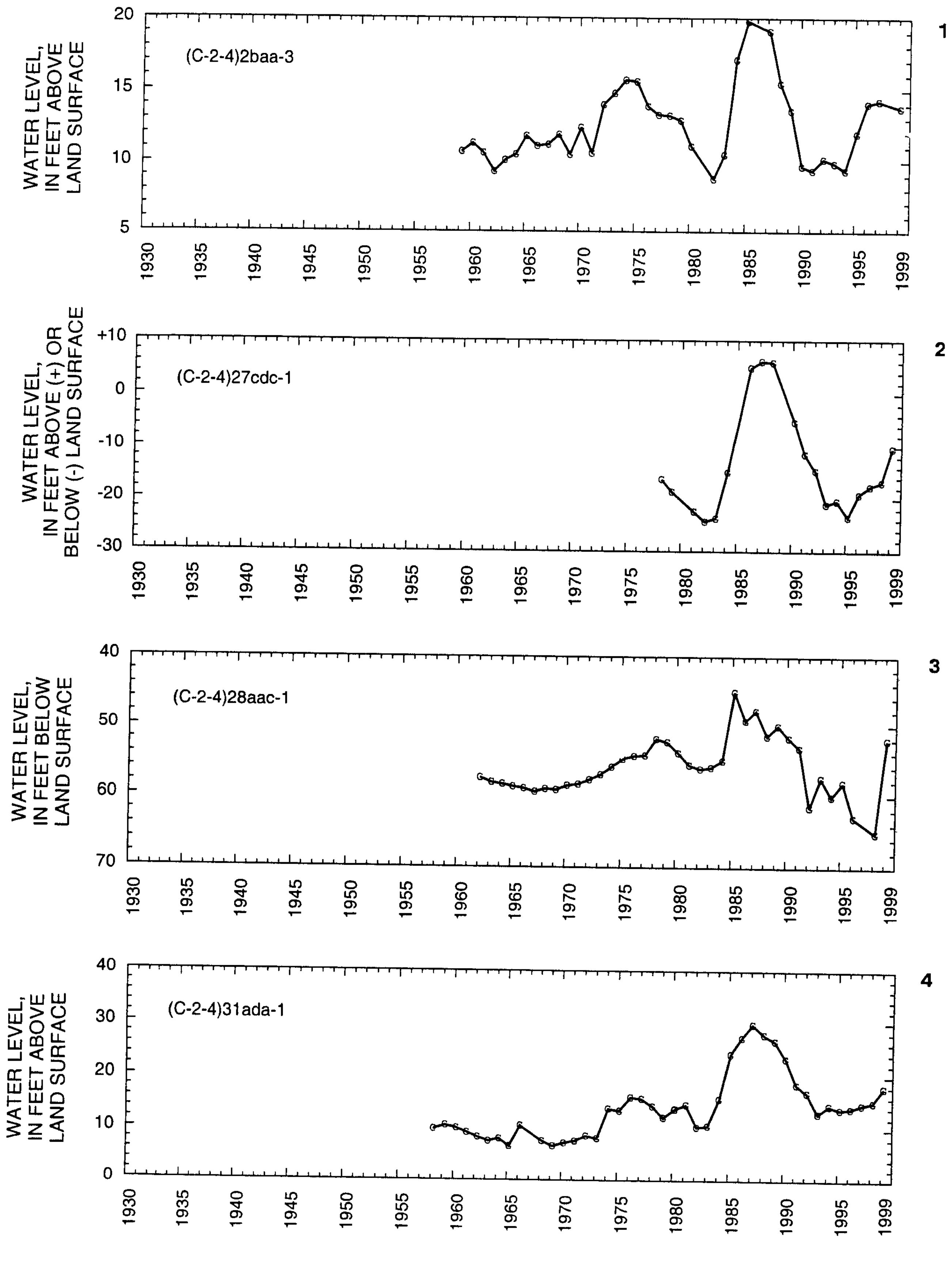


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele and to annual withdrawal from wells.

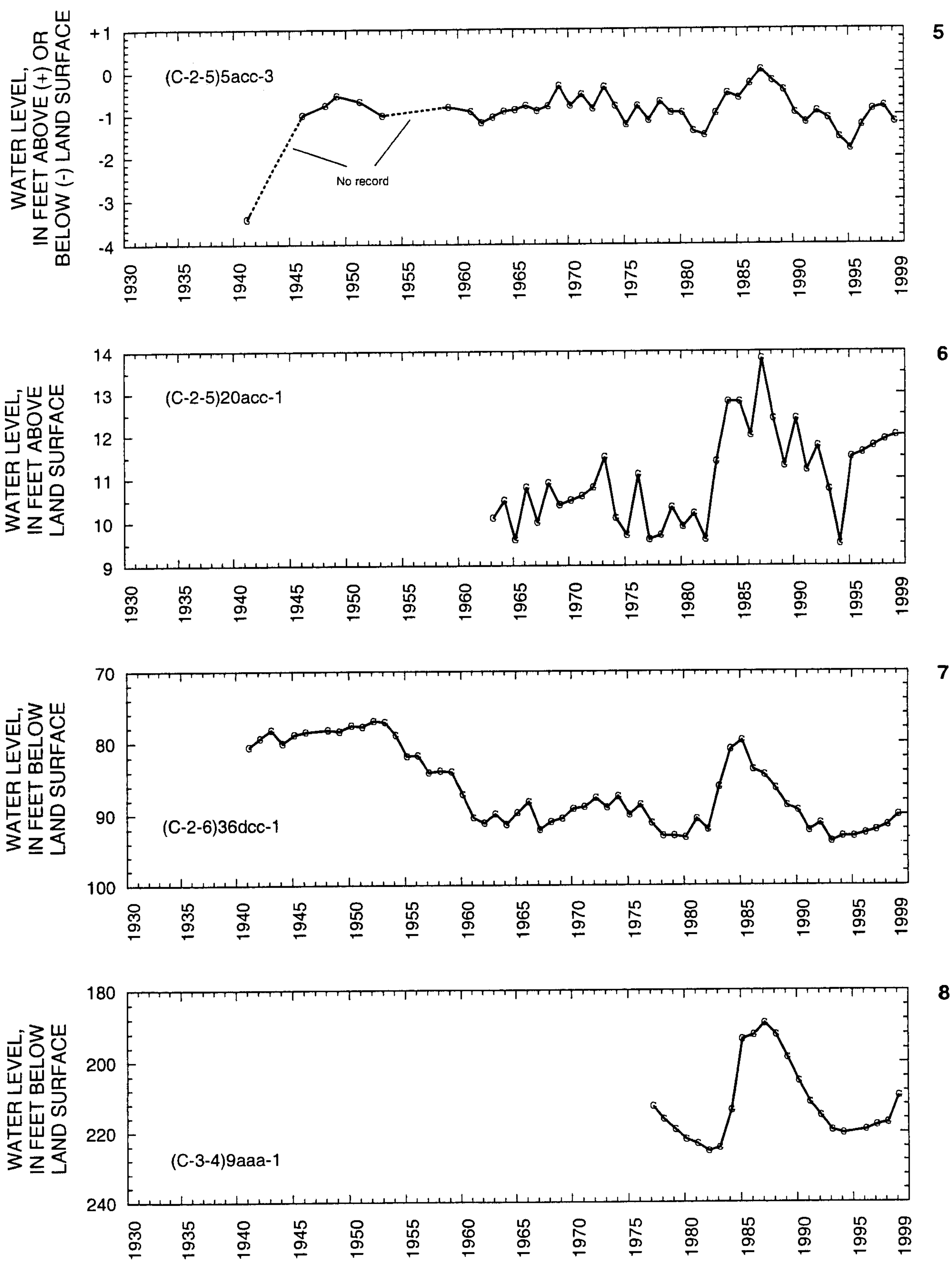


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele and to annual withdrawal from wells—Continued.

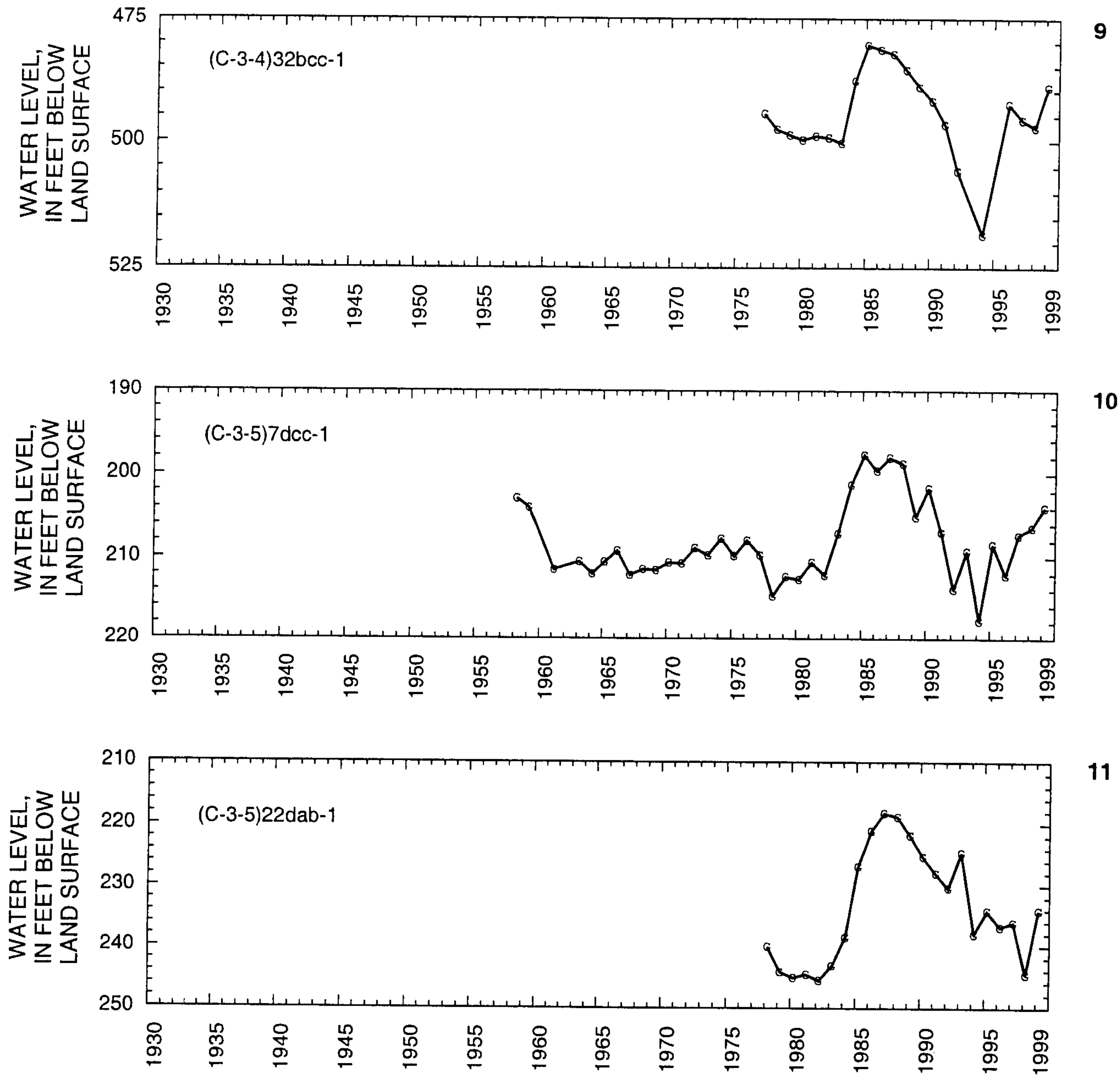


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele and to annual withdrawal from wells—Continued.

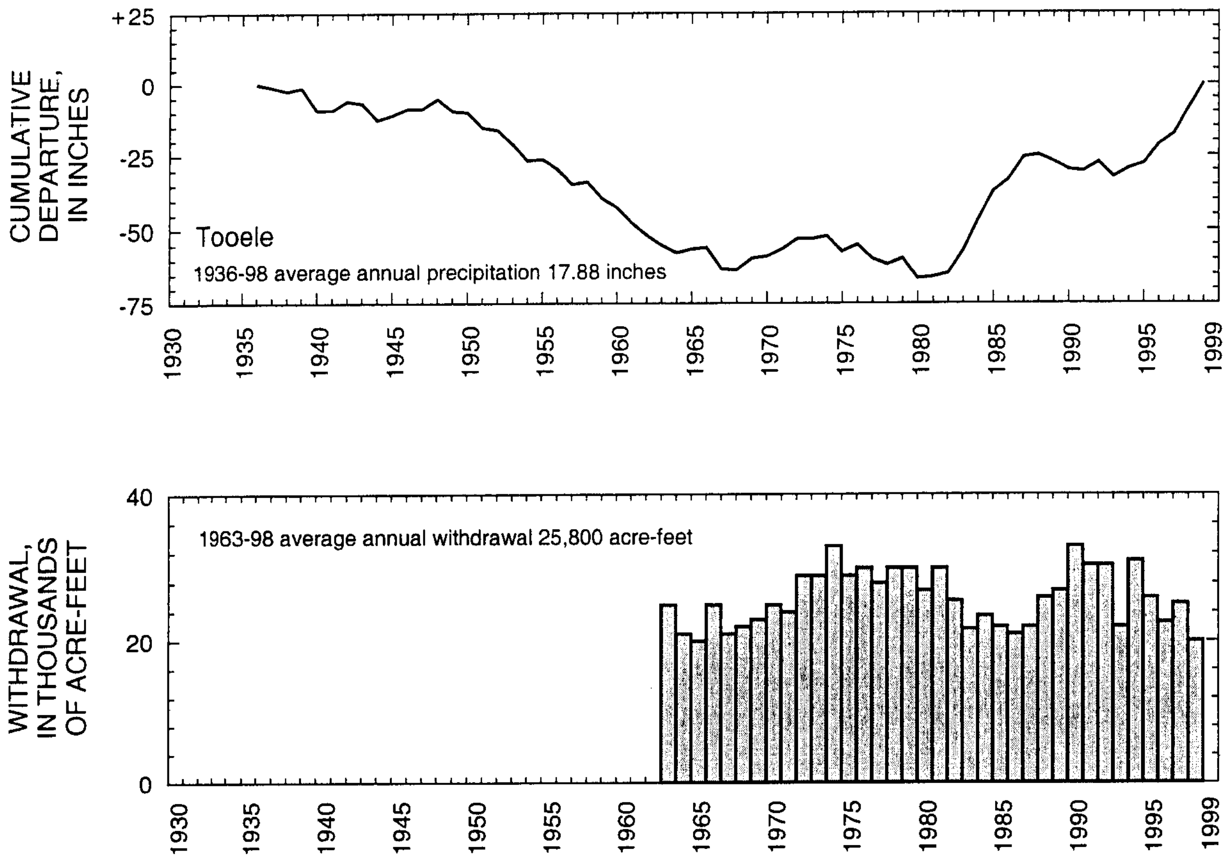


Figure 12. Relation of water level in selected wells in Tooele Valley to cumulative departure from average annual precipitation at Tooele and to annual withdrawal from wells—Continued.

UTAH AND GOSHEN VALLEYS

By S.J. Brockner

Northern Utah Valley is the part of Utah Valley that is north of Provo Bay. Ground water occurs in unconsolidated basin-fill deposits in the valley. The principal ground-water recharge area for the basin fill is in the eastern part of the valley, along the base of the Wasatch Range.

Southern Utah Valley is the part of Utah Valley south of Provo and bounded by the Wasatch Range, West Mountain, and the northern extension of Long Ridge. Goshen Valley is south of the latitude of Provo and is bounded by West Mountain, Long Ridge, and the East Tintic Mountains. Ground water occurs in the alluvium in the valleys under both water-table and artesian conditions, but most wells discharge from artesian aquifers.

Total estimated withdrawal of water from wells in Utah and Goshen Valleys in 1998 was about 86,000 acre-feet, which is 10,000 acre-feet less than was reported for 1997, and 24,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3). Withdrawal in northern Utah Valley was about 48,900 acre-feet, which is 17,000 acre-feet less than in 1997; withdrawal in southern Utah Valley was about 22,500 acre-feet, which is 2,800 acre-feet more than in 1997; withdrawal in Goshen Valley was about 14,500 acre-feet, which is 4,200 acre-feet more than in 1997. Most of the total decrease in withdrawal probably resulted from decreased withdrawal for public supply and irrigation.

The location of wells in Utah and Goshen Valleys in which the water level was measured during March 1999 is shown in figure 13. The relation of the water level in selected observation wells to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of the Spanish Fork River at Castilla, and to concentration of dissolved solids in water from three wells is shown in figure 14.

Water levels in Goshen Valley and in the northern and southern parts of Utah Valley generally rose in the early 1980s. The rise corresponds to a period of greater-than-average precipitation and recharge from surface water. Water levels generally declined from 1985 to 1993 in Utah Valley and generally have risen since 1993. This rise probably resulted from decreased withdrawal for public supply and irrigation and increased precipitation. Water levels in observation wells in Goshen Valley peaked during 1989-92 and have declined since 1992.

Discharge of the Spanish Fork River at Castilla in 1998 was 245,100 acre-feet, which is 76,800 acre-feet more than the 1933-98 annual average. Precipitation at Silver Lake near Brighton in 1998 was 49.81 inches, which is 6.93 inches more than the 1931-98 annual average and 7.09 inches more than in 1997. Precipitation at Spanish Fork Powerhouse in 1998 was 26.83 inches, which is 7.19 inches more than the 1937-98 annual average and 0.78 inch more than in 1997.

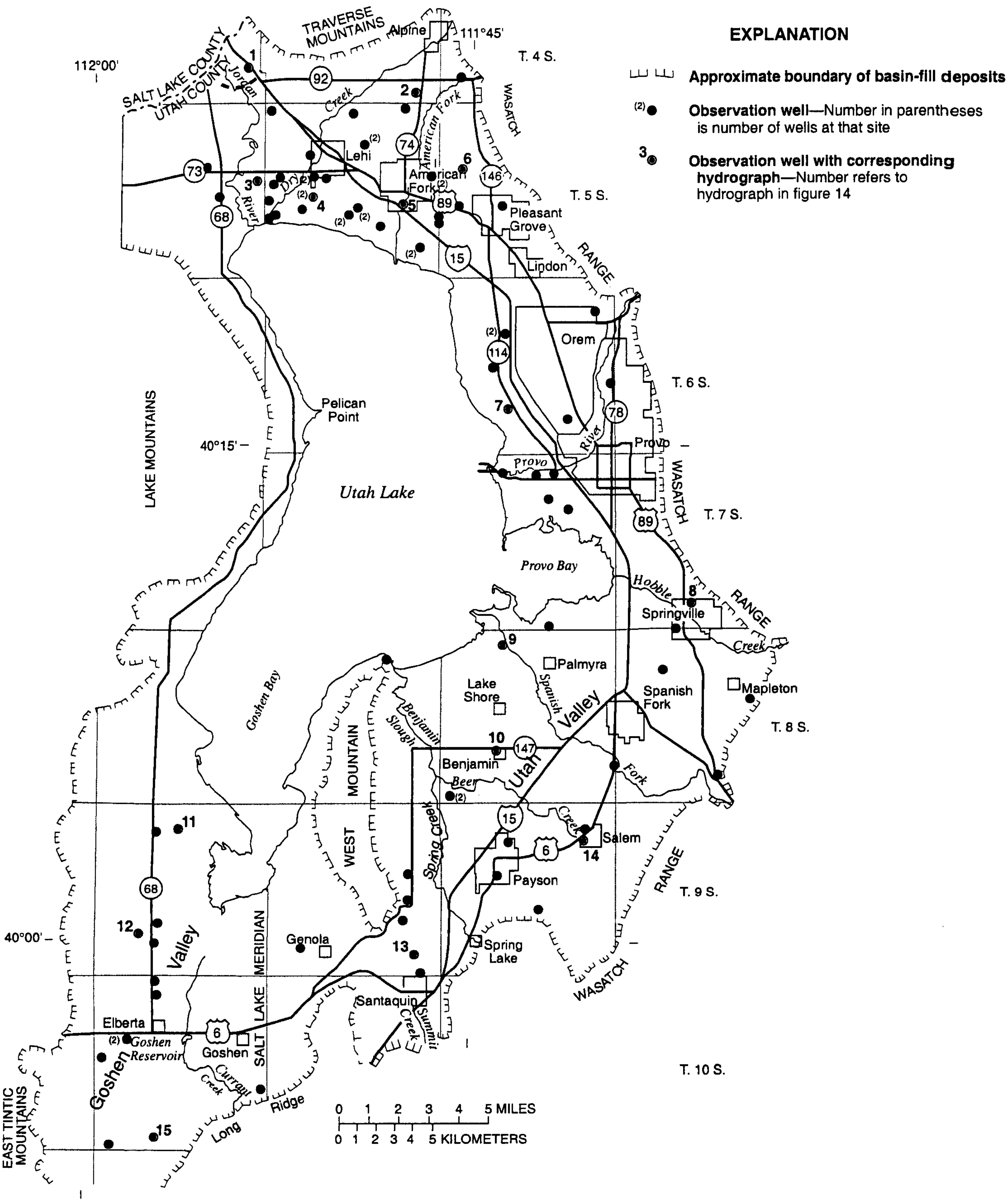


Figure 13. Location of wells in Utah and Goshen Valleys in which the water level was measured during March 1999.

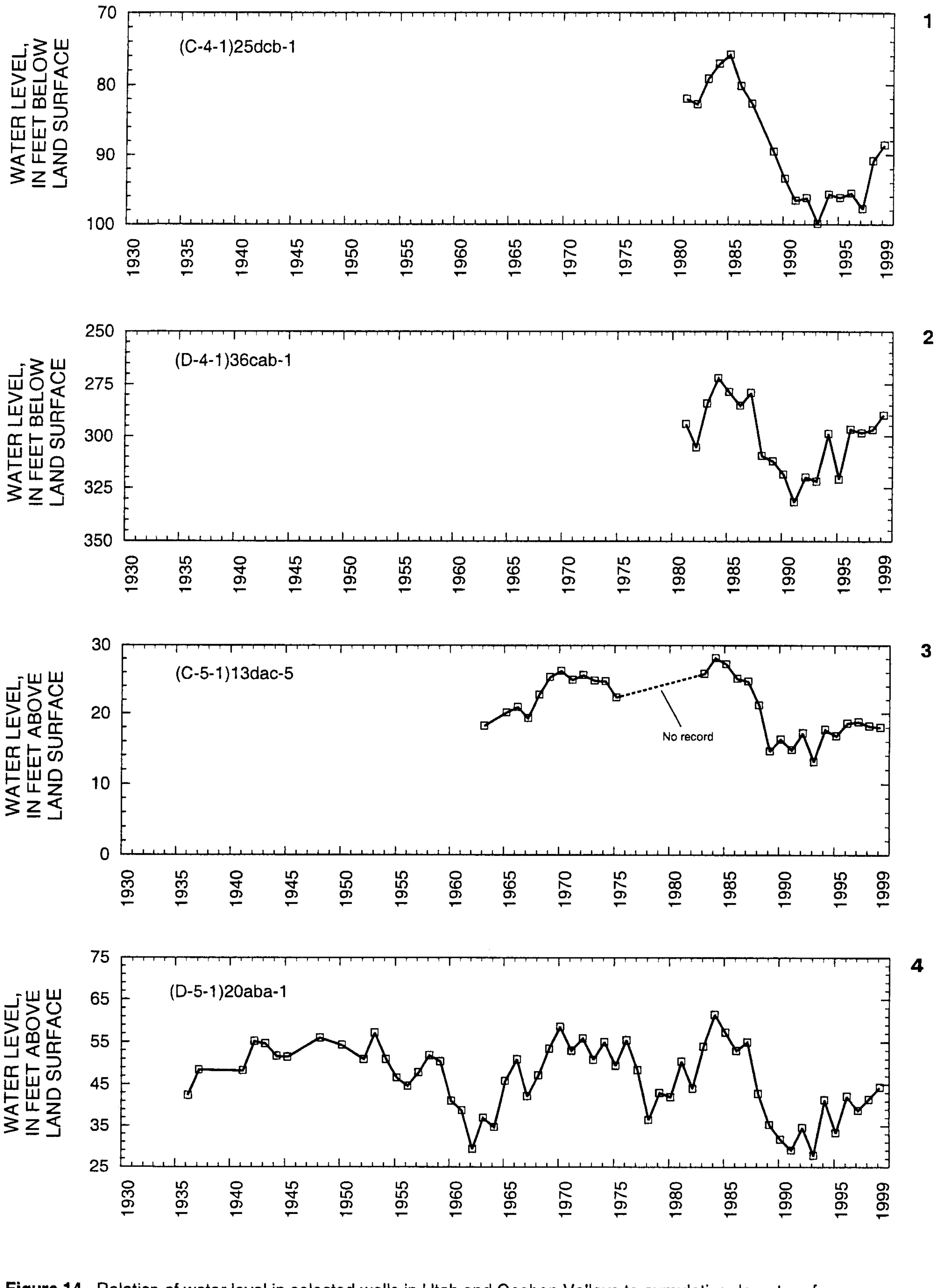


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells.

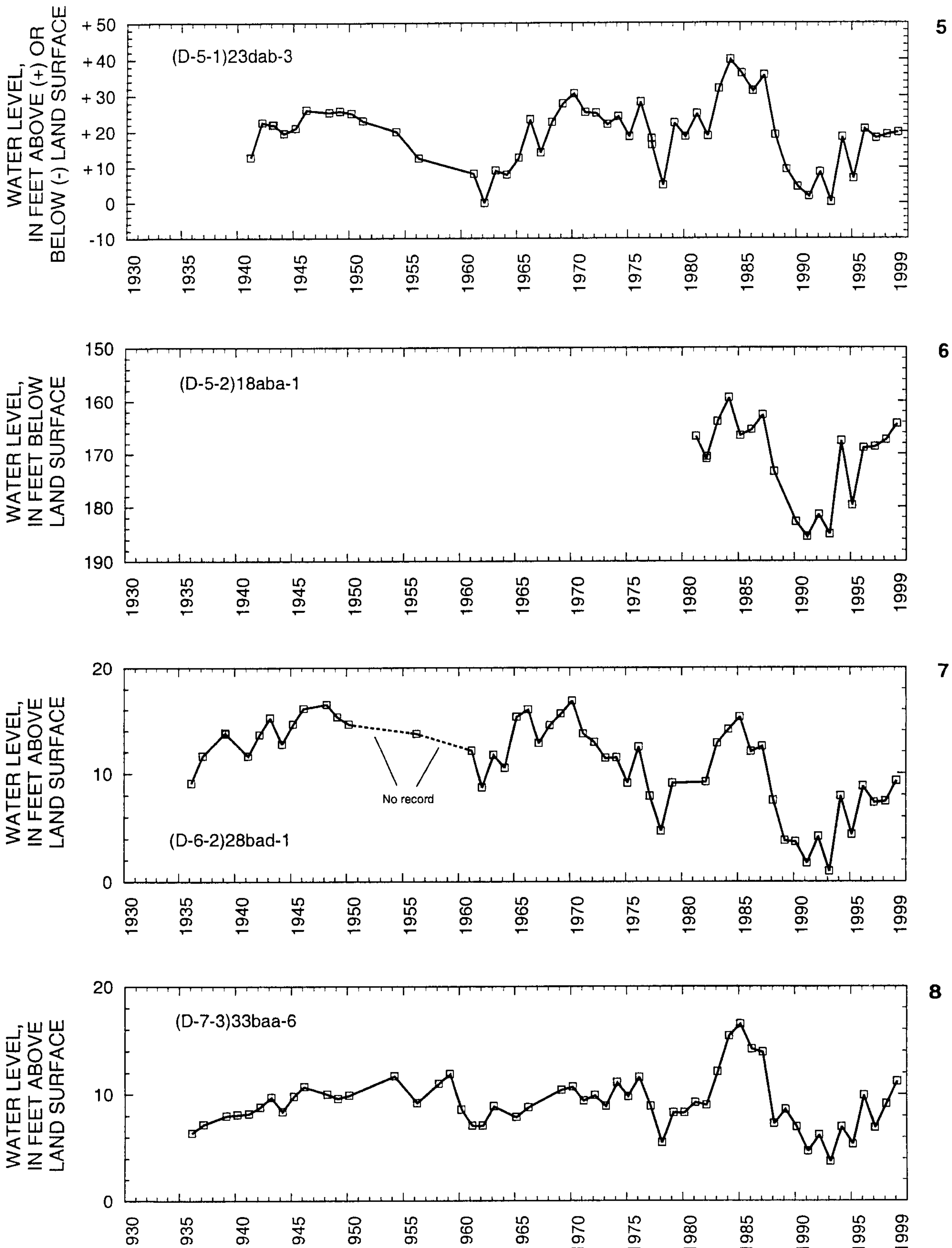
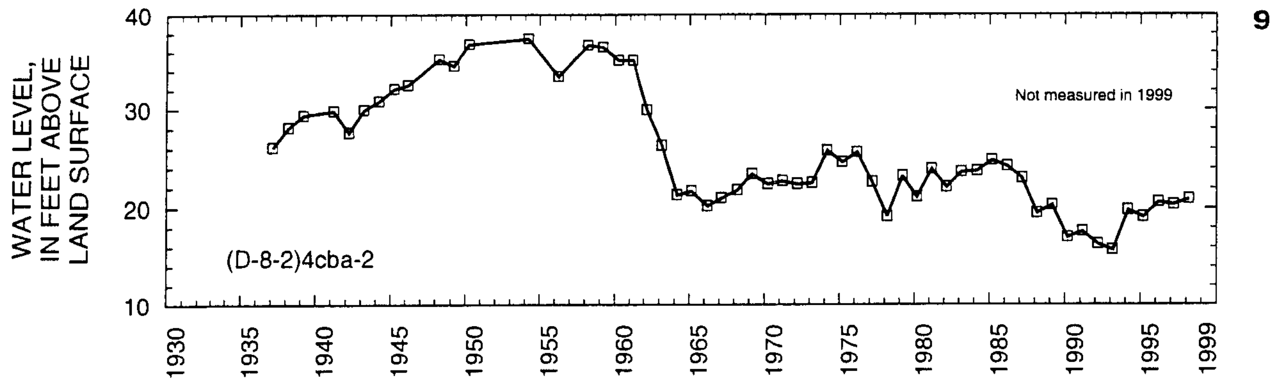
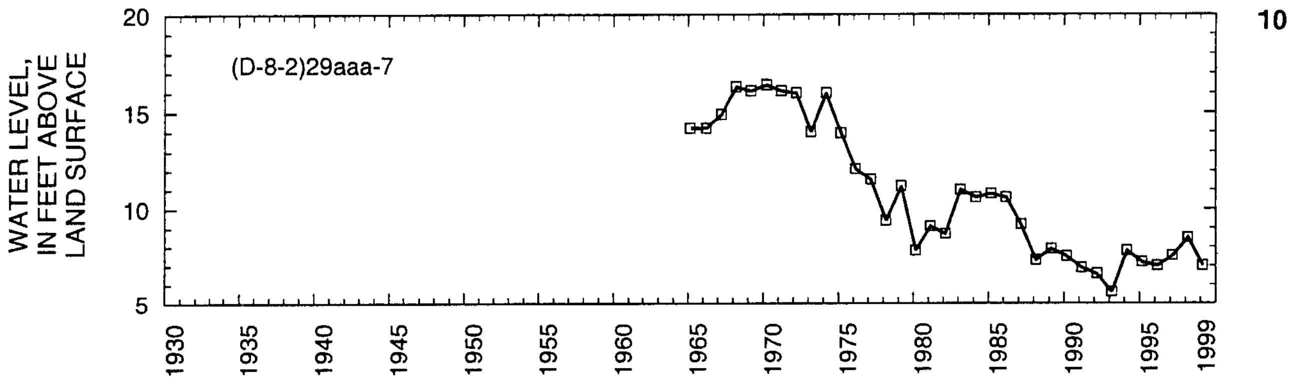
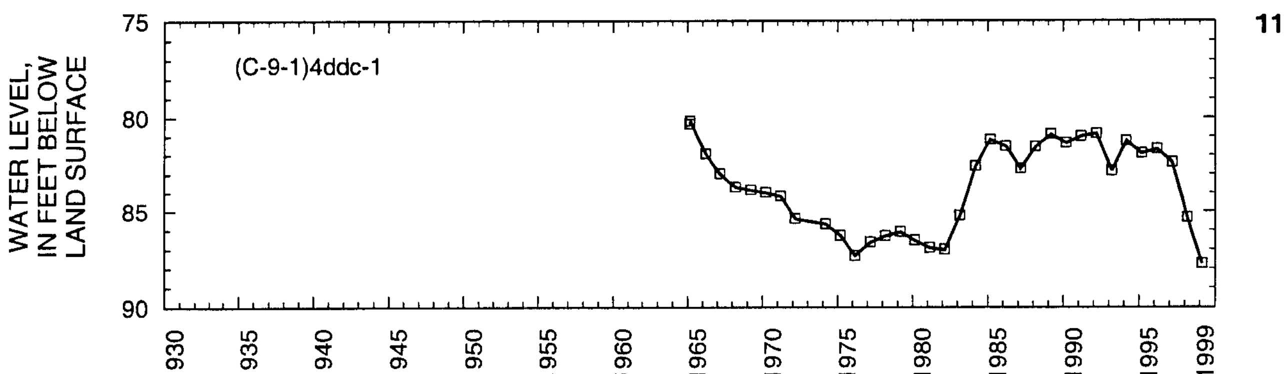


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells—Continued.







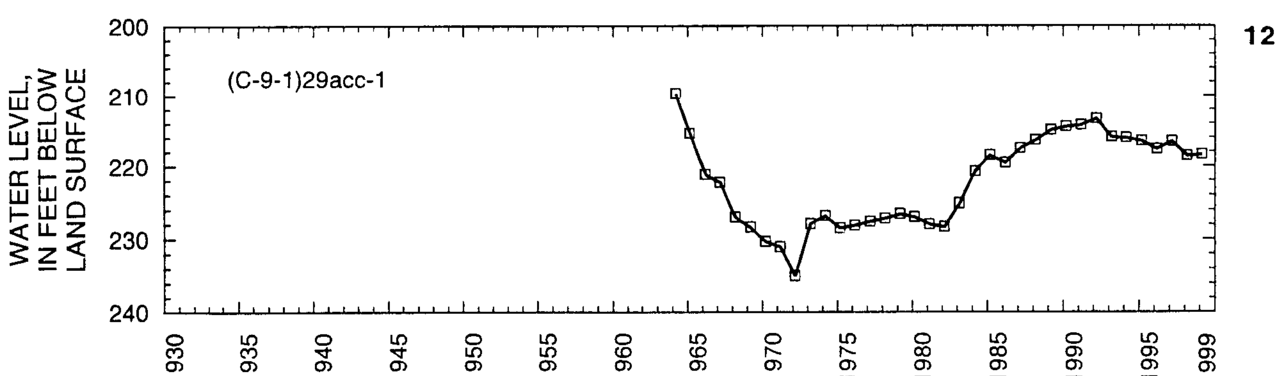
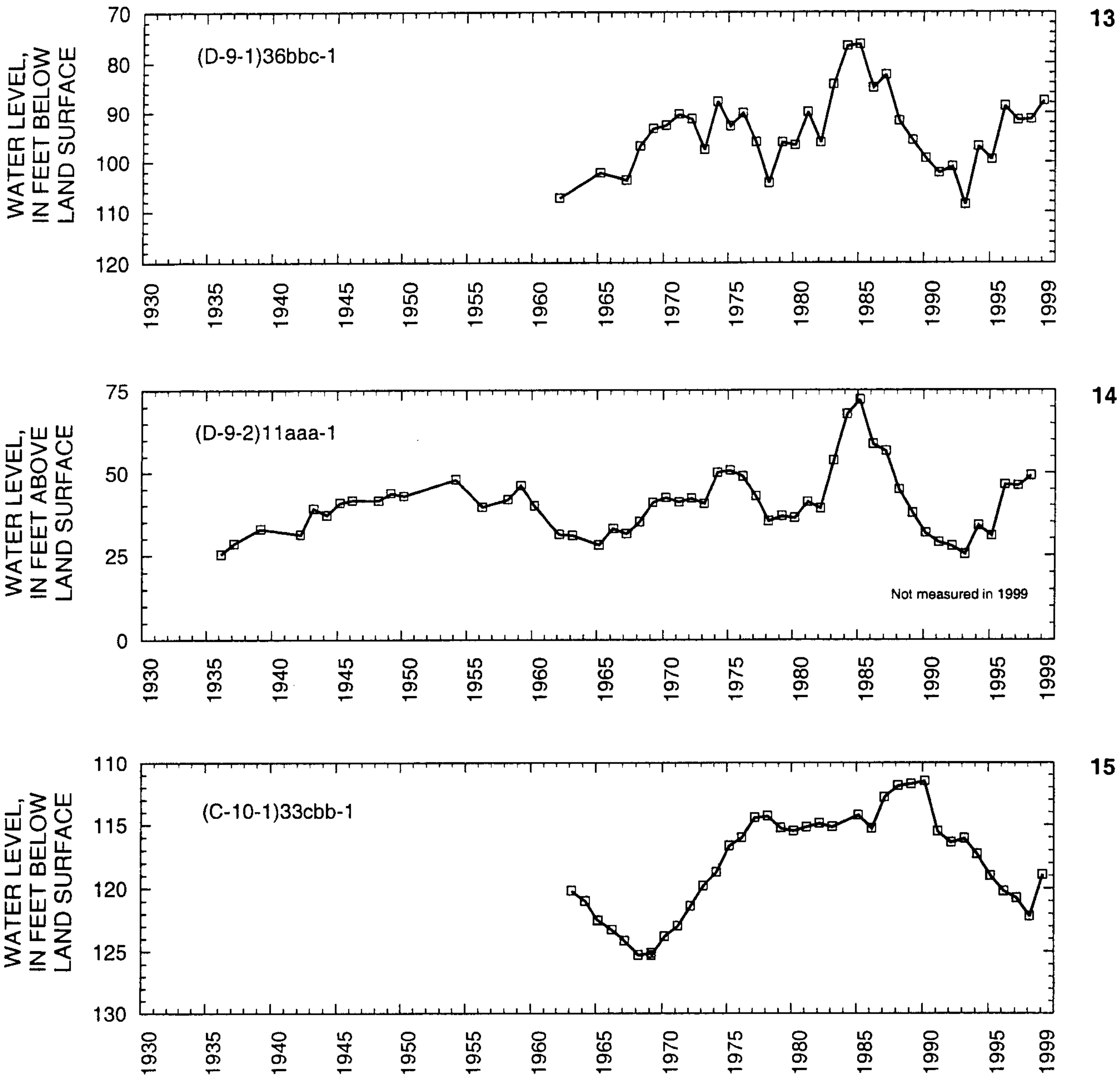


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells—Continued.



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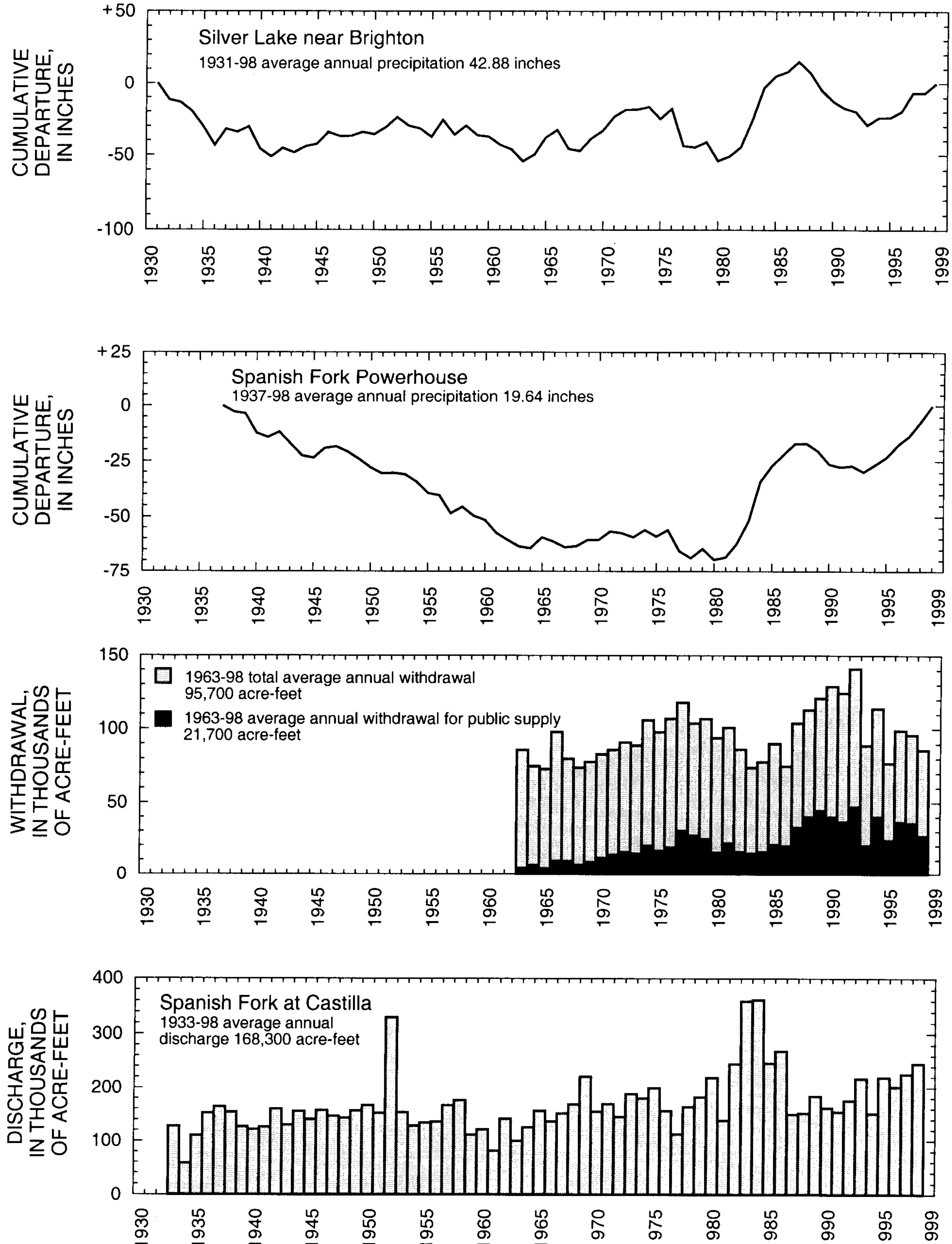

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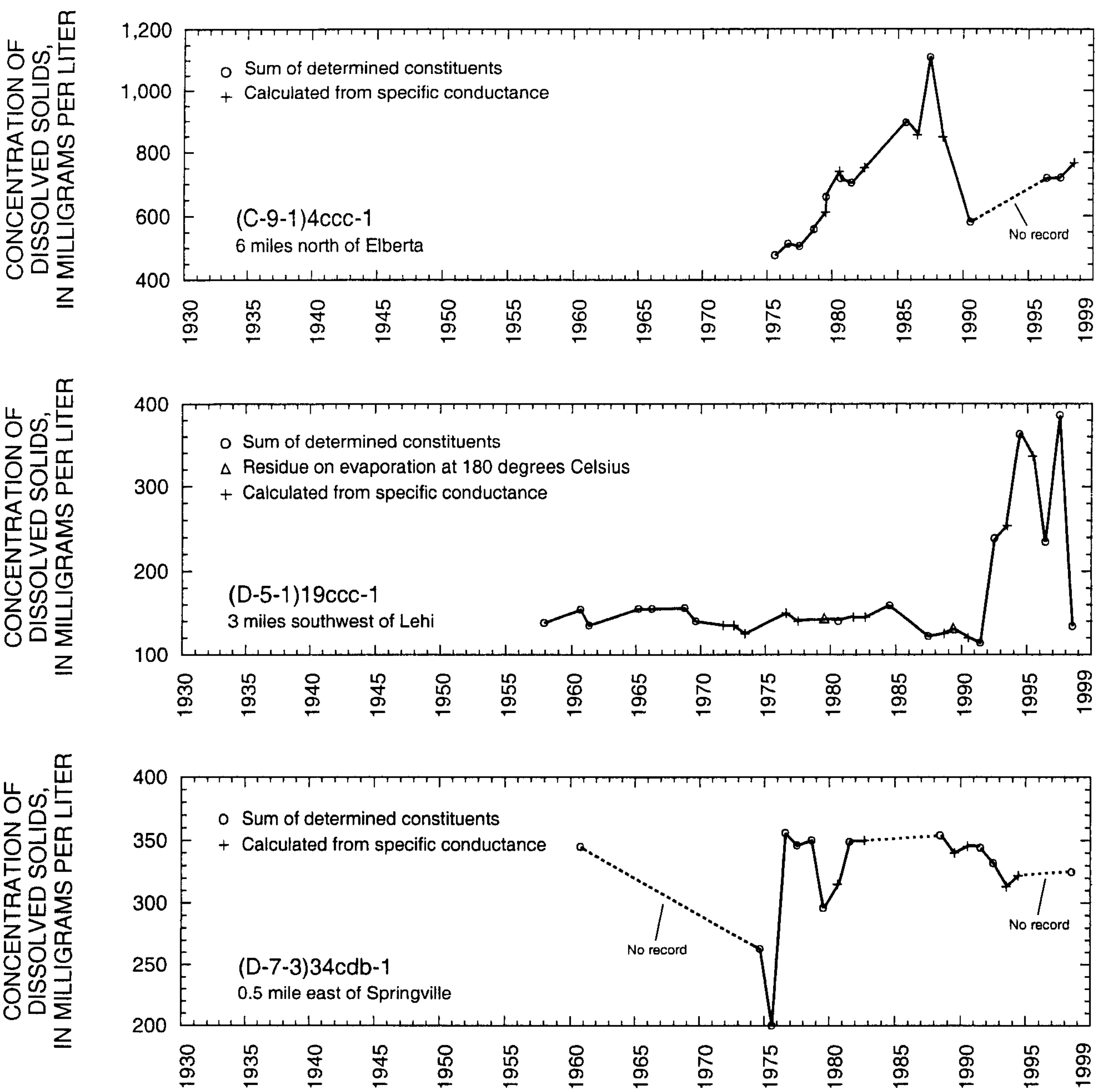


Figure 14. Relation of water level in selected wells in Utah and Goshen Valleys to cumulative departure from average annual precipitation at Silver Lake near Brighton and Spanish Fork Powerhouse, to total annual withdrawal from wells, to annual withdrawal for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from three wells—Continued.

JUAB VALLEY

By M.R. Danner

Juab Valley, which is about 30 miles long and averages about 4 miles wide, is in central Utah along the west side of the Wasatch Range and the San Pitch Mountains. The valley drains near both its northern and southern ends—in northern Juab Valley via Currant Creek into Utah Lake, and in southern Juab Valley via Chicken Creek into the Sevier River. The northern and southern parts of Juab Valley are separated topographically by Levan Ridge, a gentle rise near the midpoint of the valley floor.

The principal water-bearing formation in Juab Valley is the unconsolidated basin-fill deposits. Most of the recharge to the ground-water reservoir occurs on the eastern side of the valley along the Wasatch Range and the San Pitch Mountains; ground water moves to the lower part of the valley and to eventual discharge points at the northern and southern ends of the valleys. The ground-water divide between the northern and southern parts of Juab Valley is slightly south of Levan Ridge.

Ground water occurs in the unconsolidated deposits under both water-table and artesian conditions, but artesian conditions are prevalent in the lower part of the valley. The greatest depths to water are along the eastern margin of the valley, where permeable alluvial fans extend from the mountains into the valley.

Total estimated withdrawal of water from pumped and flowing wells in Juab Valley in 1998 was about 12,000 acre-feet, which is 3,000 acre-feet less than was reported for 1997 and 10,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3). The decrease in withdrawals from wells mostly resulted from decreases in irrigation and public supply uses.

The location of wells in Juab Valley in which the water level was measured during March 1999 is shown in figure 15. The relation of the water level in selected wells to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1 is shown in figure 16. Water levels in March rose in five of the six observation wells north of Levan Ridge and rose in all four wells south of Levan Ridge from 1998 to 1999. This rise in water levels probably resulted from decreased withdrawals and greater-than-average precipitation. Water levels in March generally rose from 1978 to their highest level in 1985. This rise corresponds to a period of greater-than-average precipitation during 1978-86. Water levels generally declined from 1986 to 1993 and generally have risen since 1993.

Precipitation at Nephi during 1998 was 19.31 inches, which is 4.78 inches more than the average annual precipitation for 1935-98, and 1.50 inches more than in 1997. The concentration of dissolved solids in water from well (D-13-1)7dbc-1 fluctuated during 1964-98 with a slight upward trend.

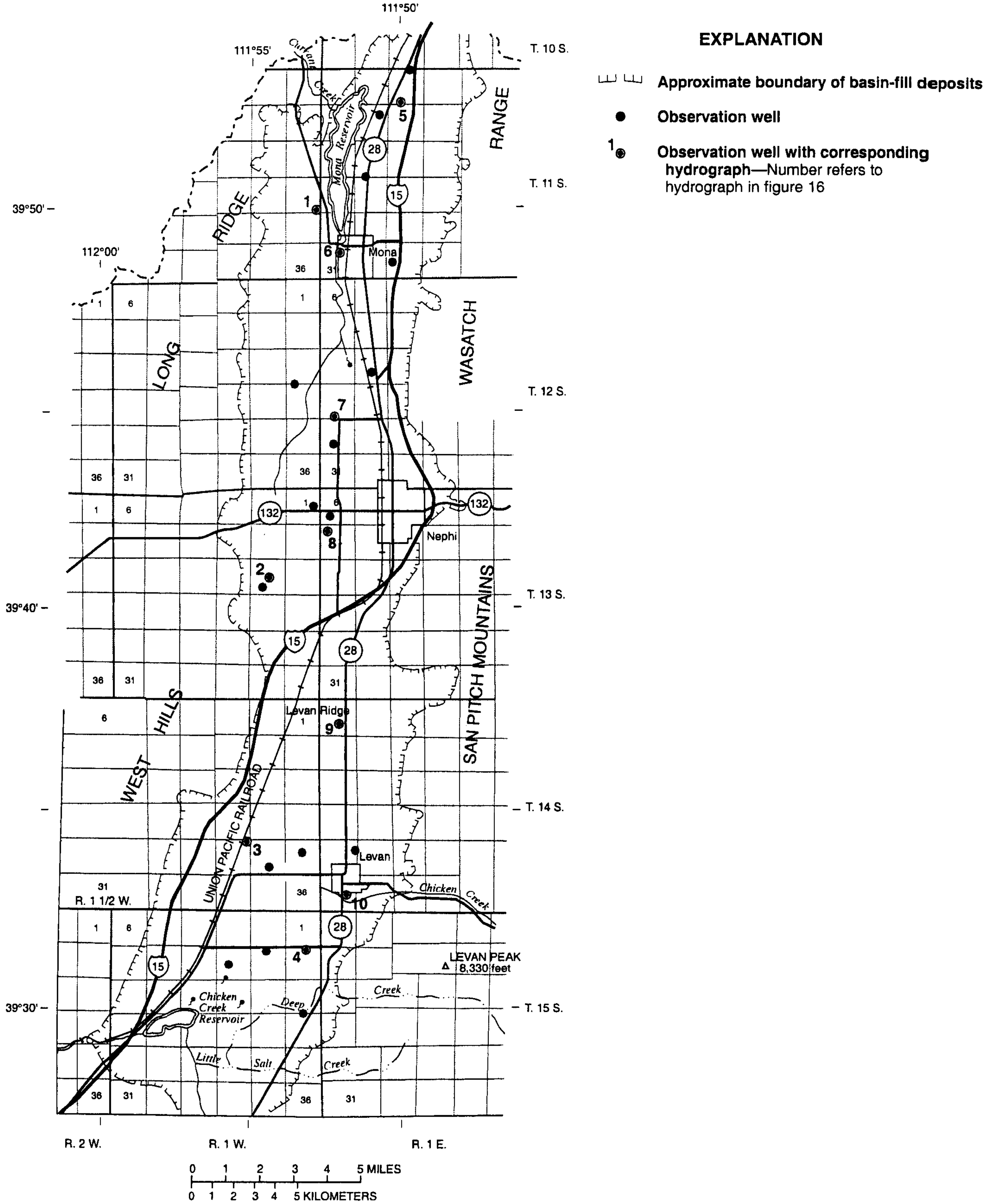


Figure 15. Location of wells in Juab Valley in which the water level was measured during March 1999.

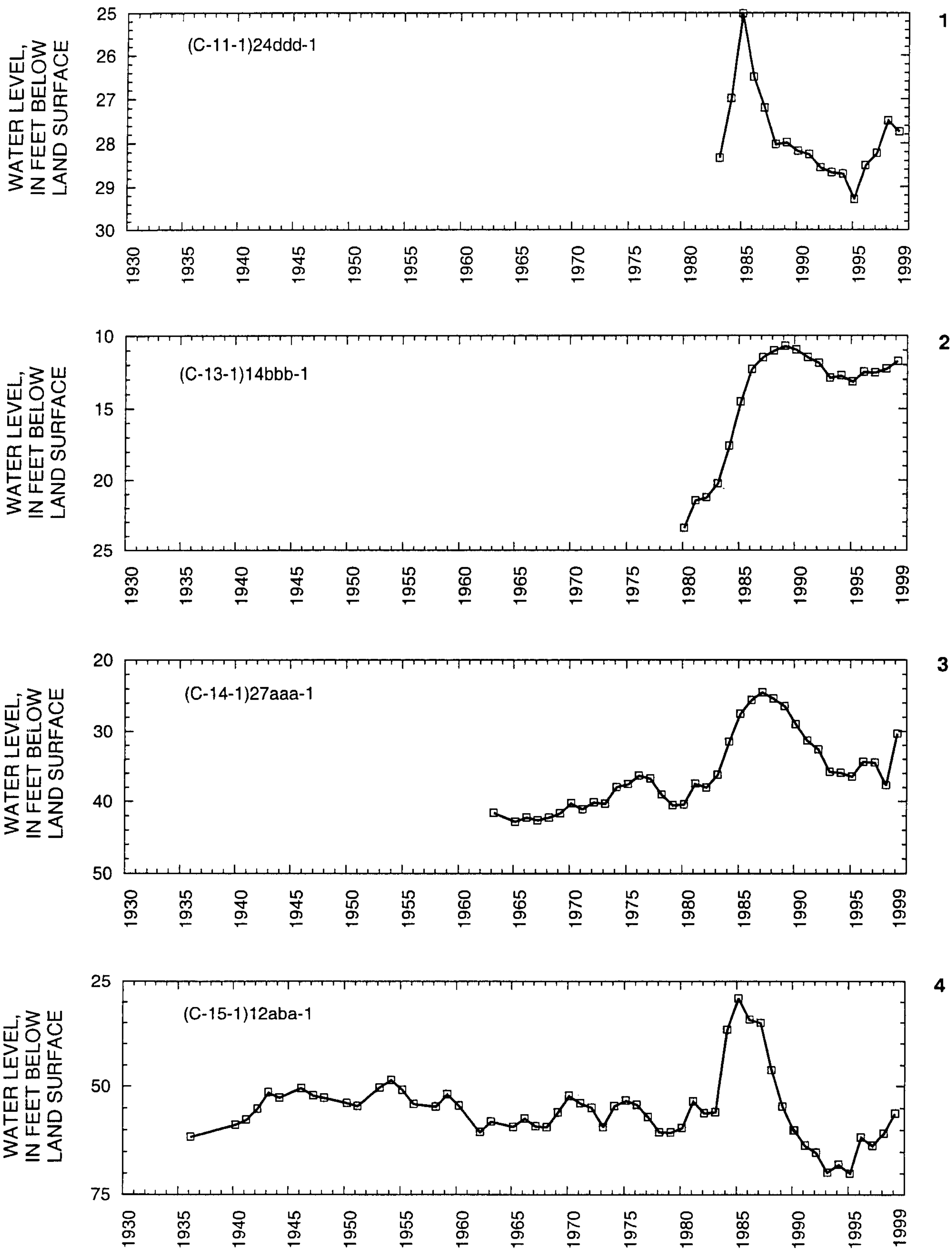


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1.

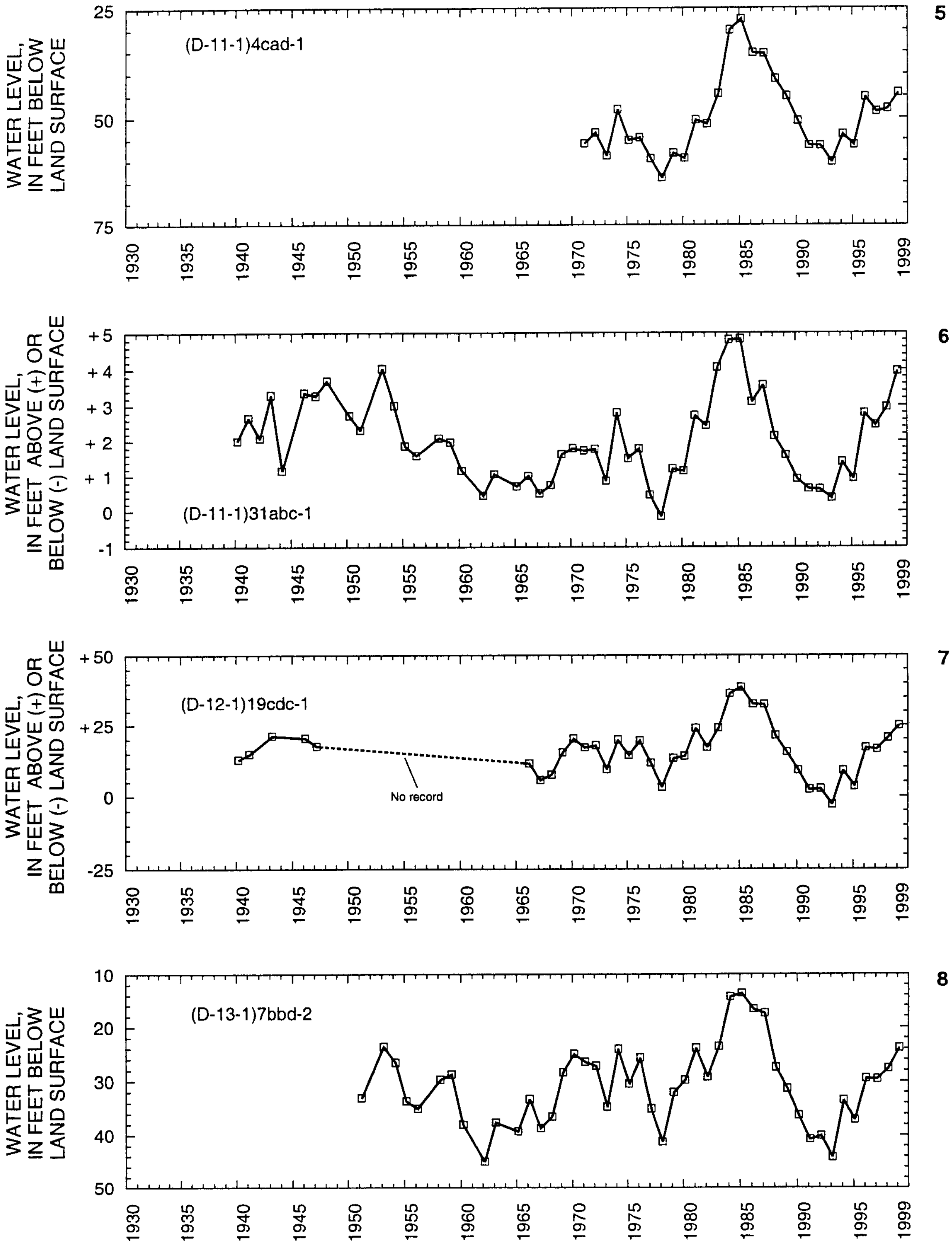
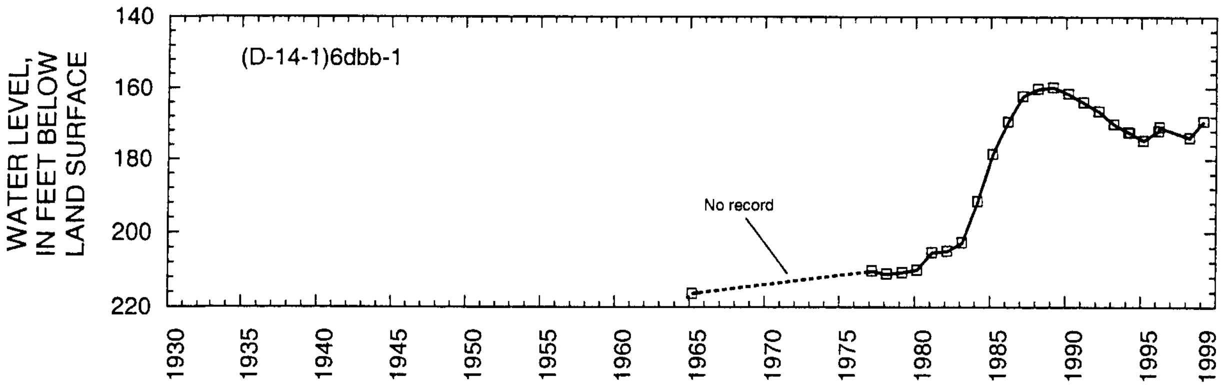


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1—Continued.



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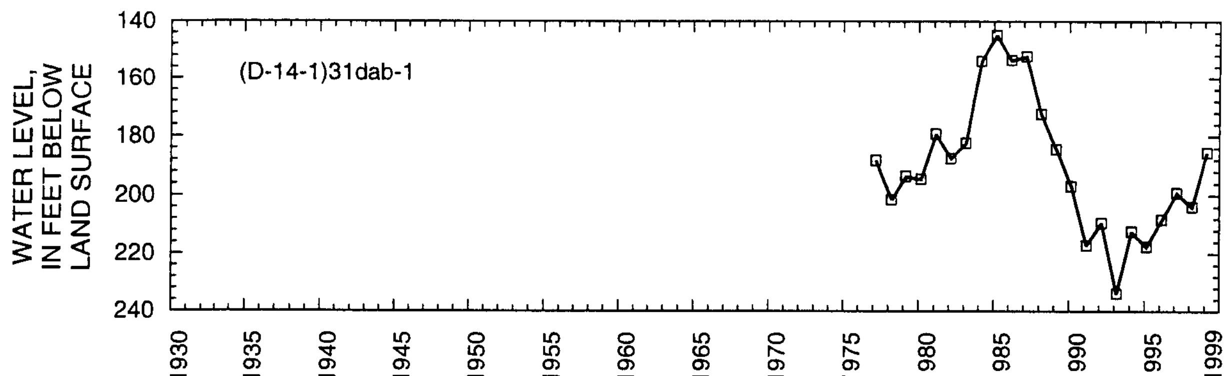

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Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1—Continued.

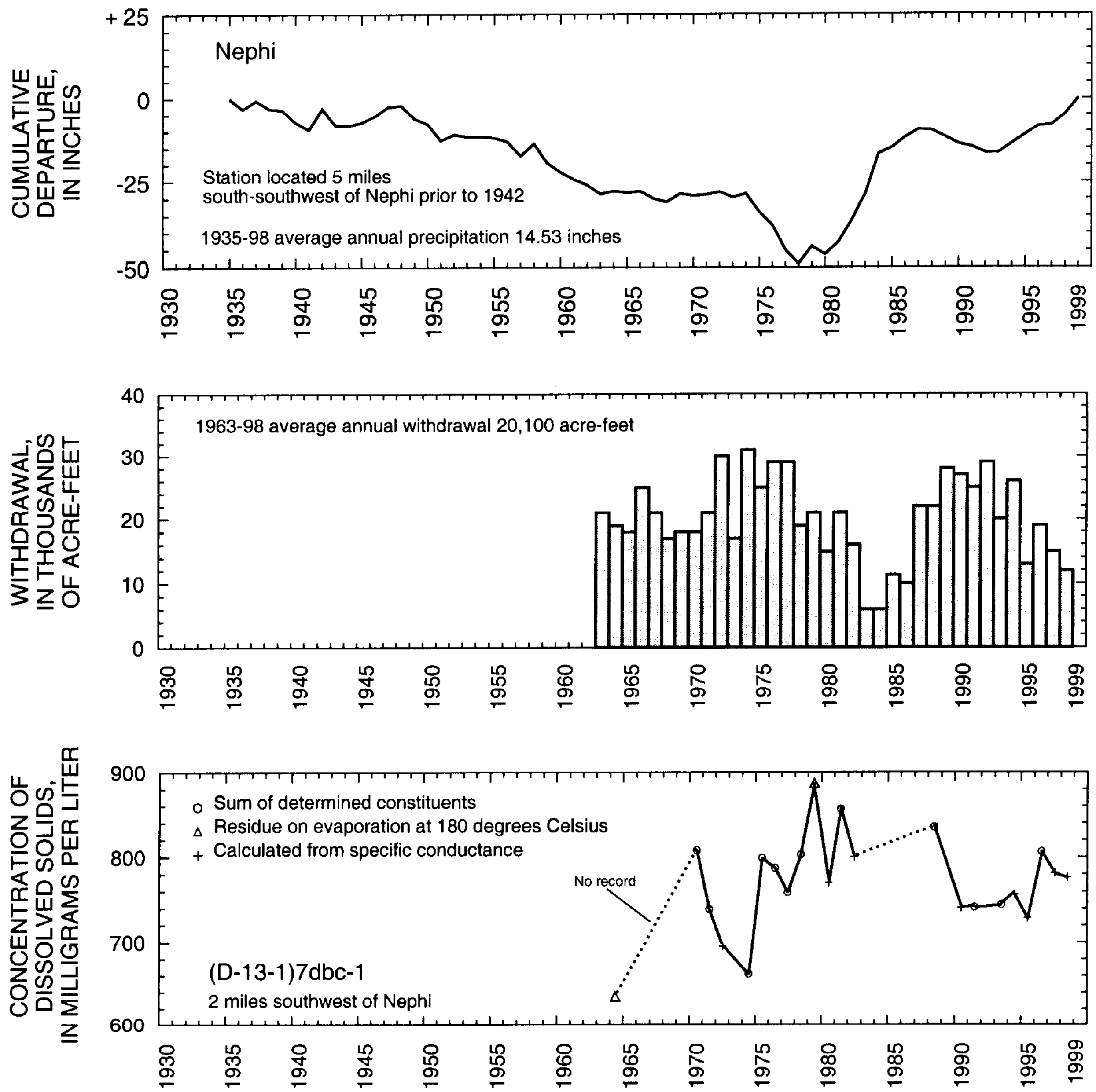


Figure 16. Relation of water level in selected wells in Juab Valley to cumulative departure from average annual precipitation at Nephi, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1—Continued.

SEVIER DESERT

By Paul Downhour

The part of the Sevier Desert described here covers about 3,100 square miles. It is principally the broad, gently sloping area between the Canyon and Tintic Mountains on the east and the Drum Mountains on the west, and between Clear Lake and the north end of Sevier Lake on the south and the Sheeprock and Simpson Mountains on the north.

Ground water occurs in the Sevier Desert in unconsolidated deposits under water-table and artesian conditions. Most of the ground water is discharged from wells tapping either of two artesian aquifers—the upper or lower artesian aquifer.

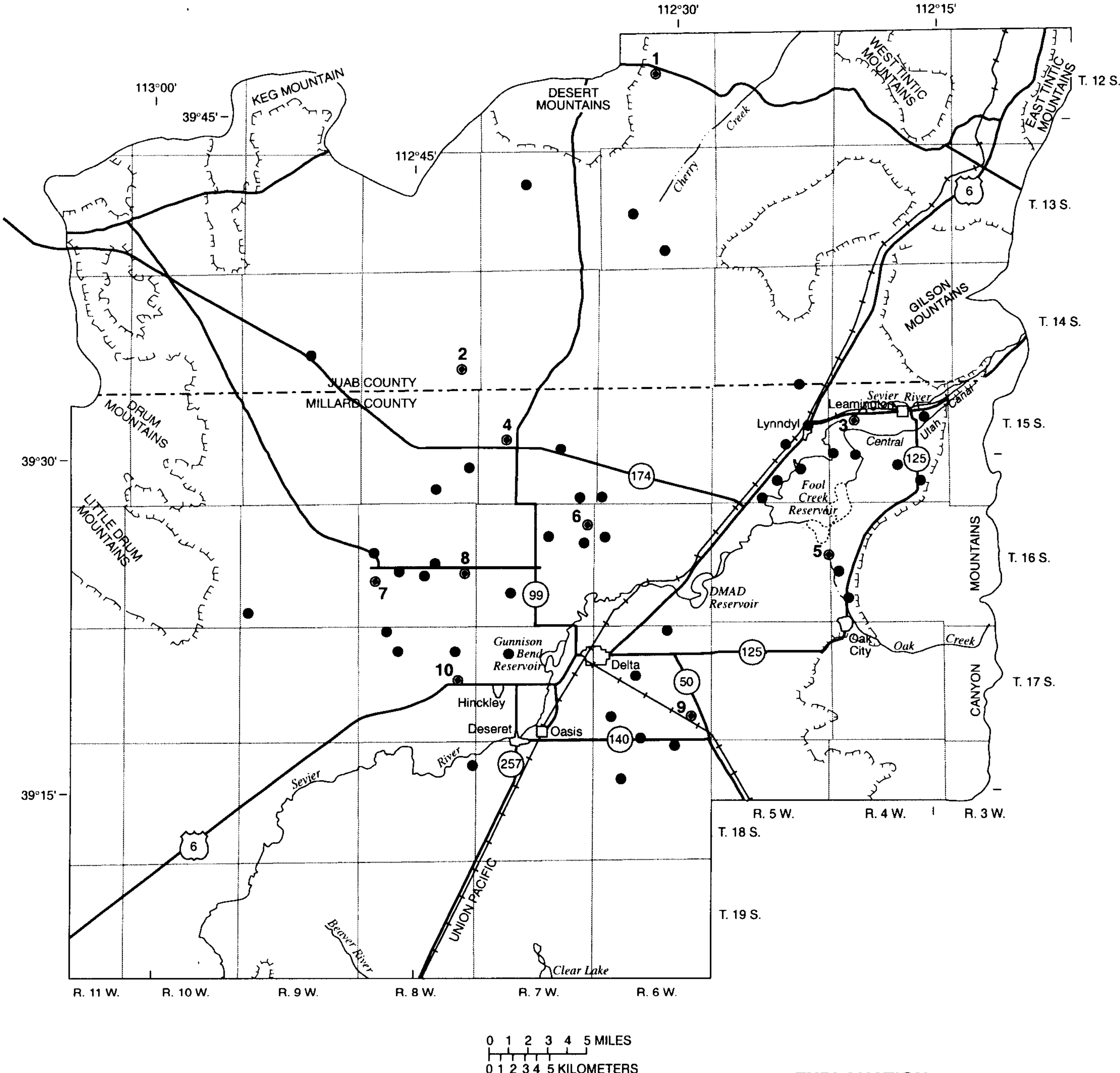
Total estimated withdrawal of water from wells in the Sevier Desert in 1998 was about 12,000 acre-feet, which is 5,000 acre-feet less than in 1997 and about 13,000 acre-feet less than the 1988-97 average annual withdrawal (tables 2 and 3). The decrease in withdrawals mostly resulted from decreases in irrigation use.

The location of wells in the Sevier Desert in which the water level was measured during March 1999 is shown in figures 17 and 18. The relation of the water level in selected wells to annual discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1 is shown in figure 19. Water levels in both the shallow and deep aquifers in the Sevier Desert rose from 1980 to 1988, which corresponds to a period of greater-than-average precipitation and less-than-average withdrawal. Water levels in both aquifers began declining during 1987-90, continued to decline until 1995, and generally have risen or remained stable since 1995. Rises since 1995 probably resulted from decreased withdrawal and greater-than-average precipitation, resulting in more available surface water for irrigation.

Discharge of the Sevier River in 1998 was 310,700 acre-feet, 152,700 acre-feet more than in 1997 and 126,900 acre-feet more than the long-term average (1935-98).

Precipitation at Oak City was 20.31 inches in 1998, 7.29 inches more than the 1935-98 average annual precipitation and 2.89 inches more than in 1997.

The concentration of dissolved solids in water from well (C-15-4)18daa-1, near Lynndyl, has increased from about 900 milligrams per liter in 1958 to about 1,900 milligrams per liter in 1996. This increase probably resulted from recharge from irrigation water, which contained more dissolved solids than local ground water (Handy and others, 1969).



EXPLANATION

Approximate boundary of basin-fill deposits

Observation well

9 **Observation well with corresponding hydrograph**—Number refers to hydrograph in figure 19

Figure 17. Location of wells in the shallow artesian aquifer in part of the Sevier Desert in which the water level was measured during March 1999.

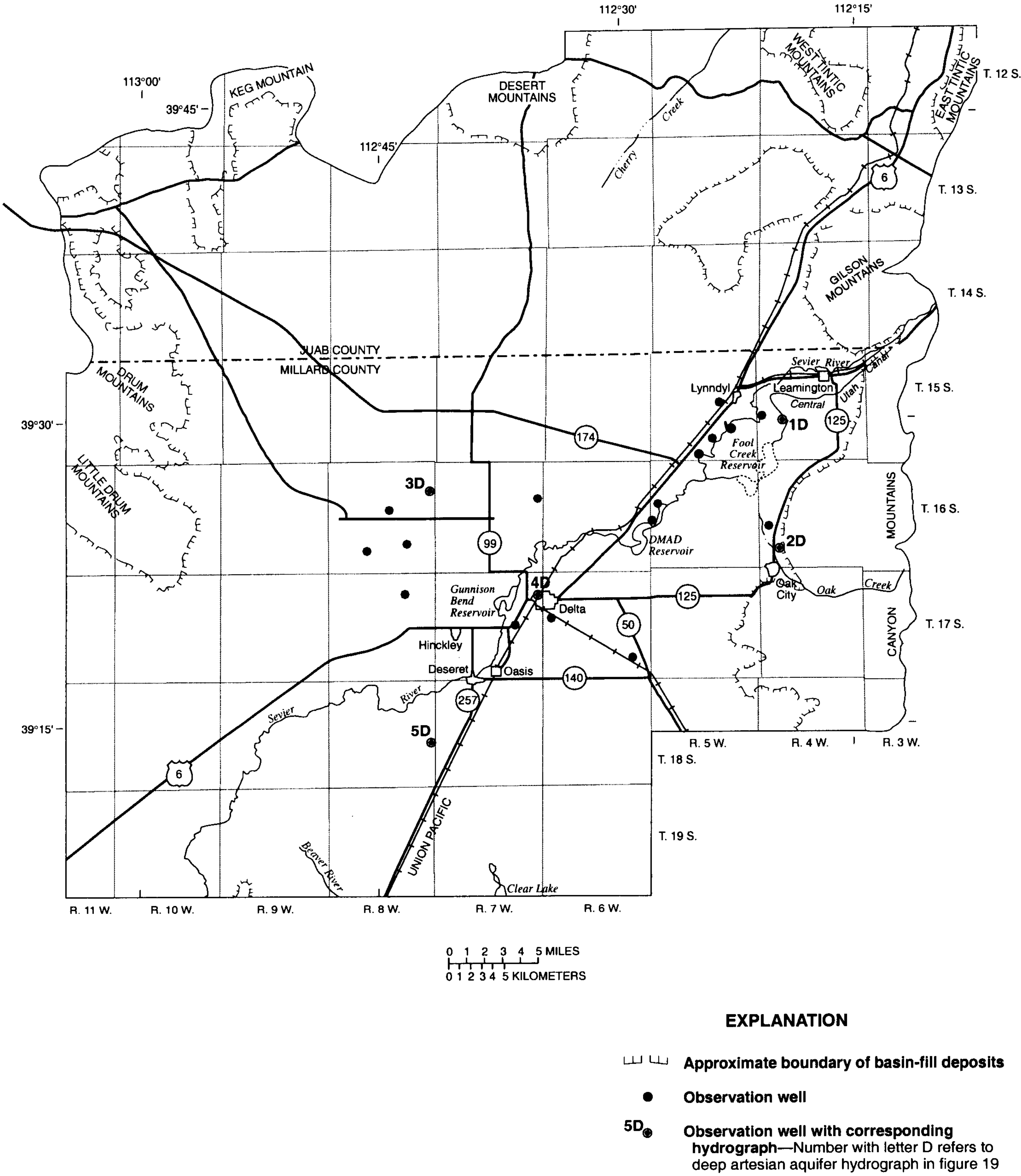


Figure 18. Location of wells in the deep artesian aquifer in part of the Sevier Desert in which the water level was measured during March 1999.

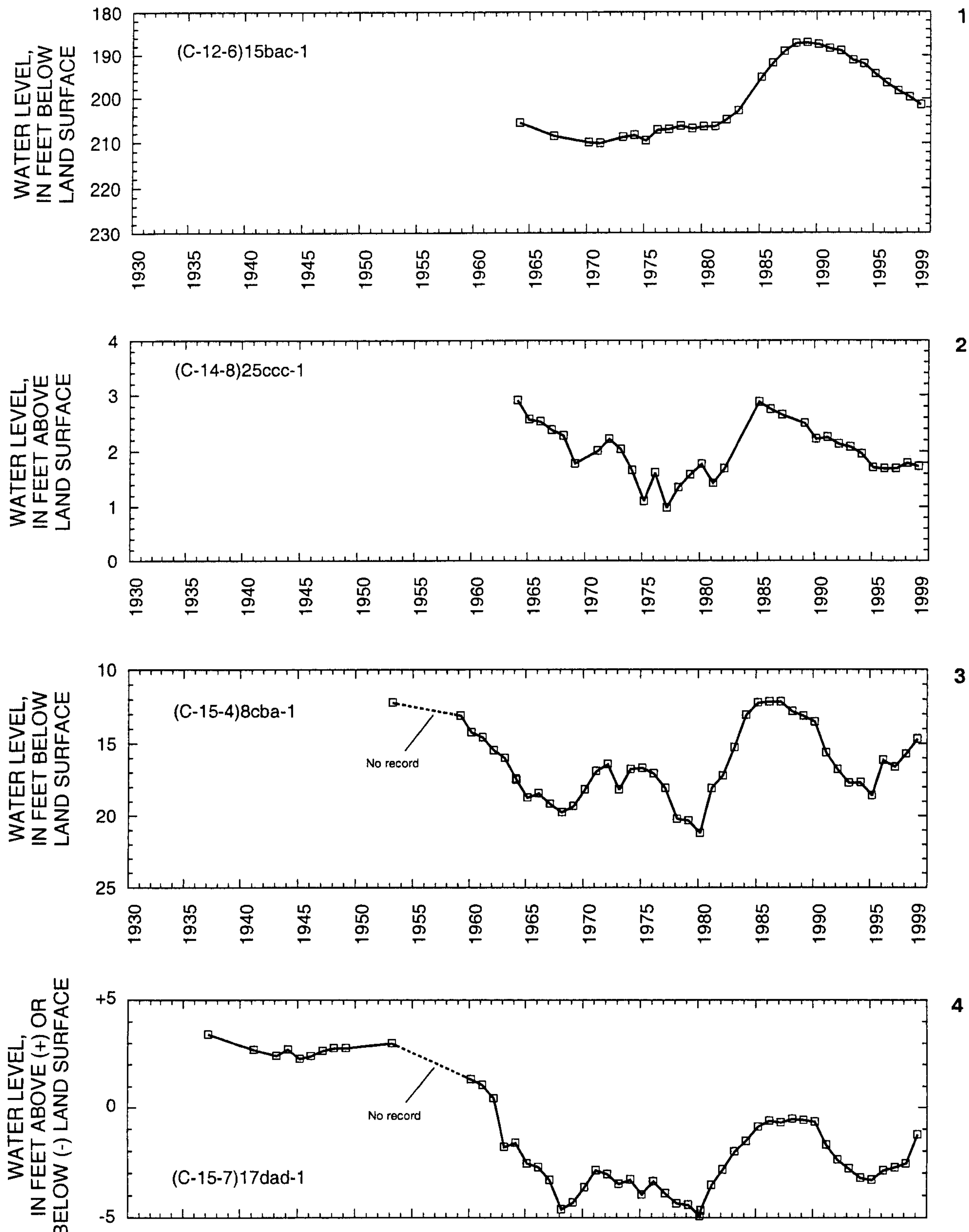


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1.

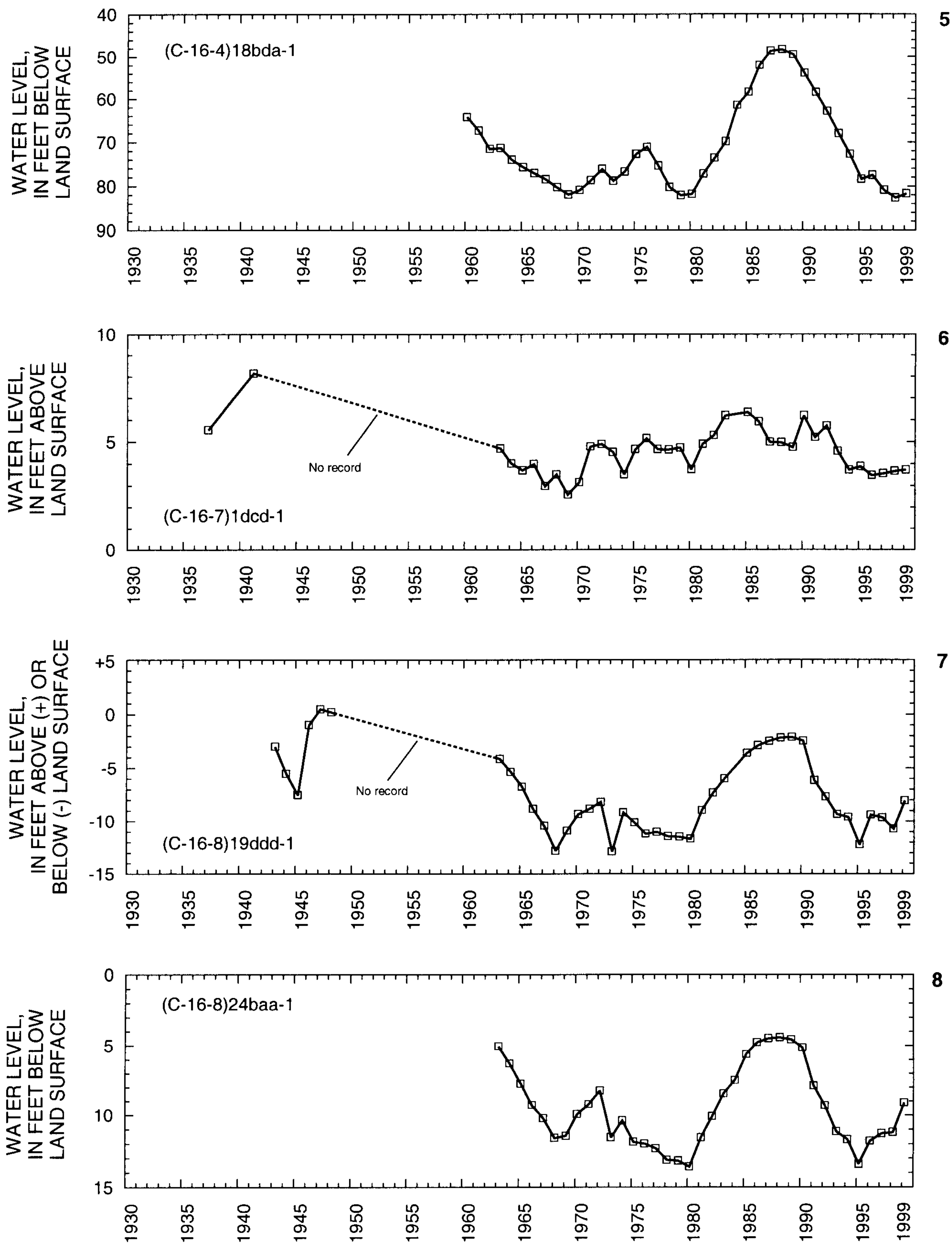
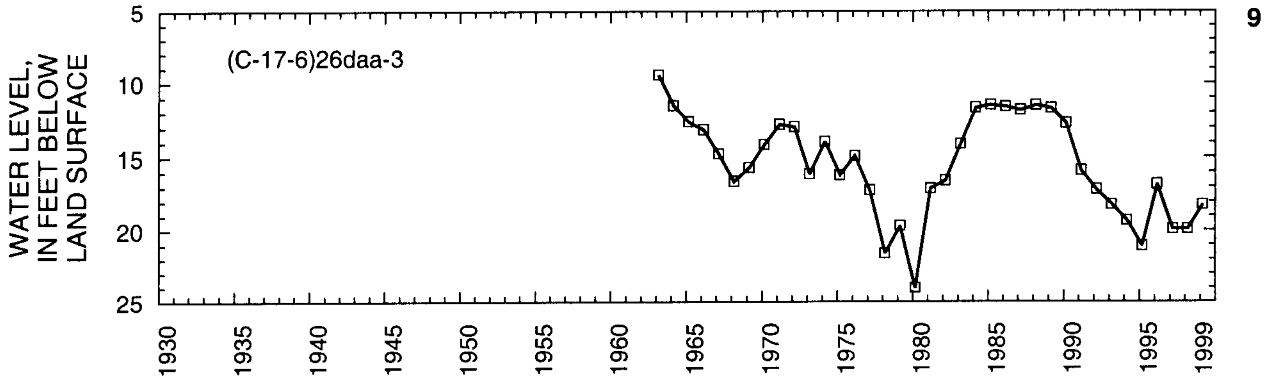
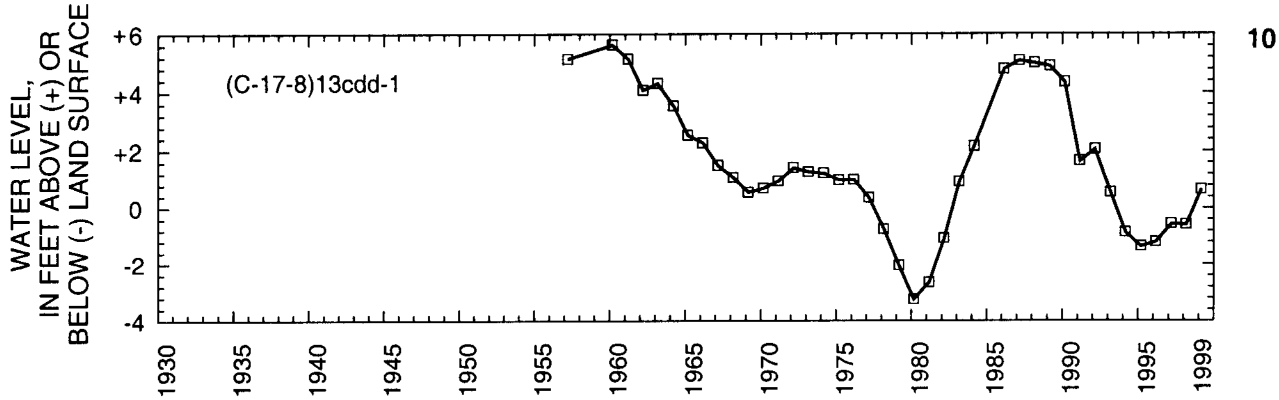
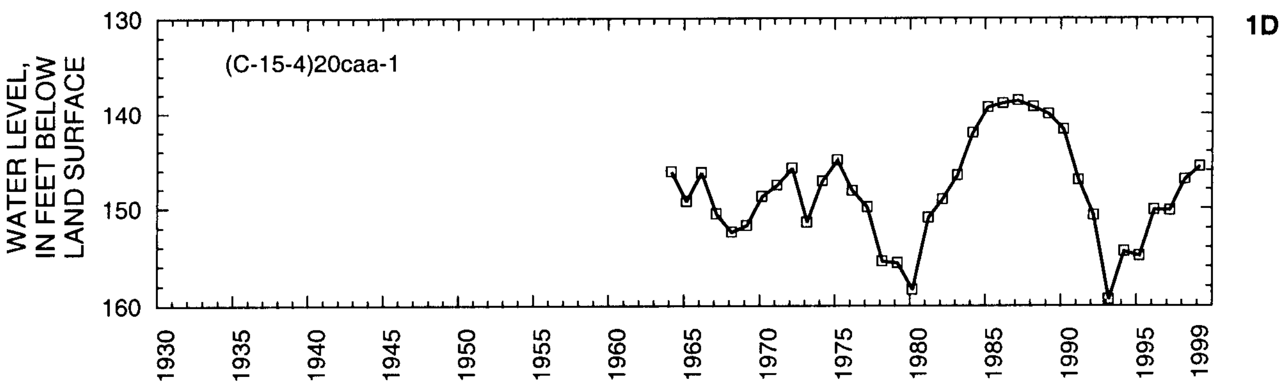


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1—Continued.







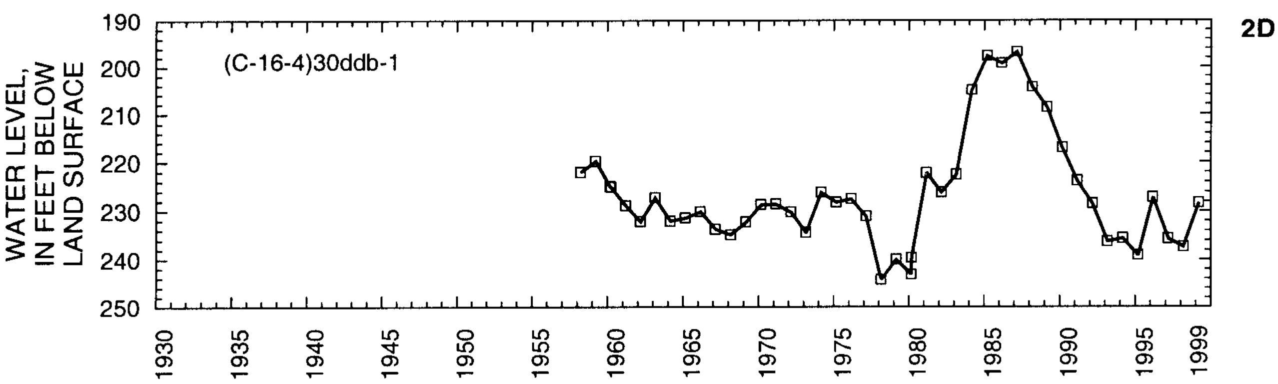


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1—Continued.

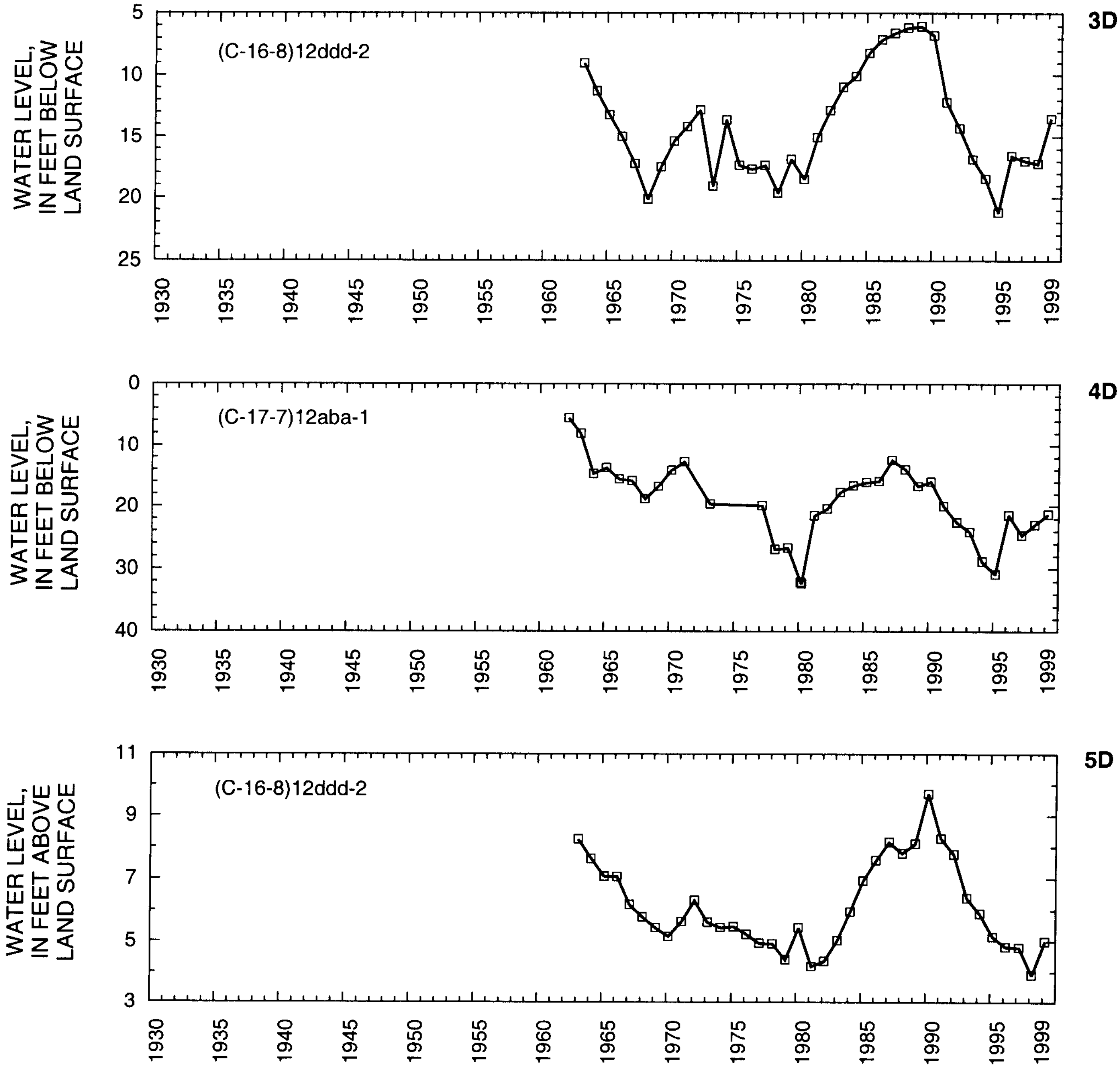


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1—Continued.

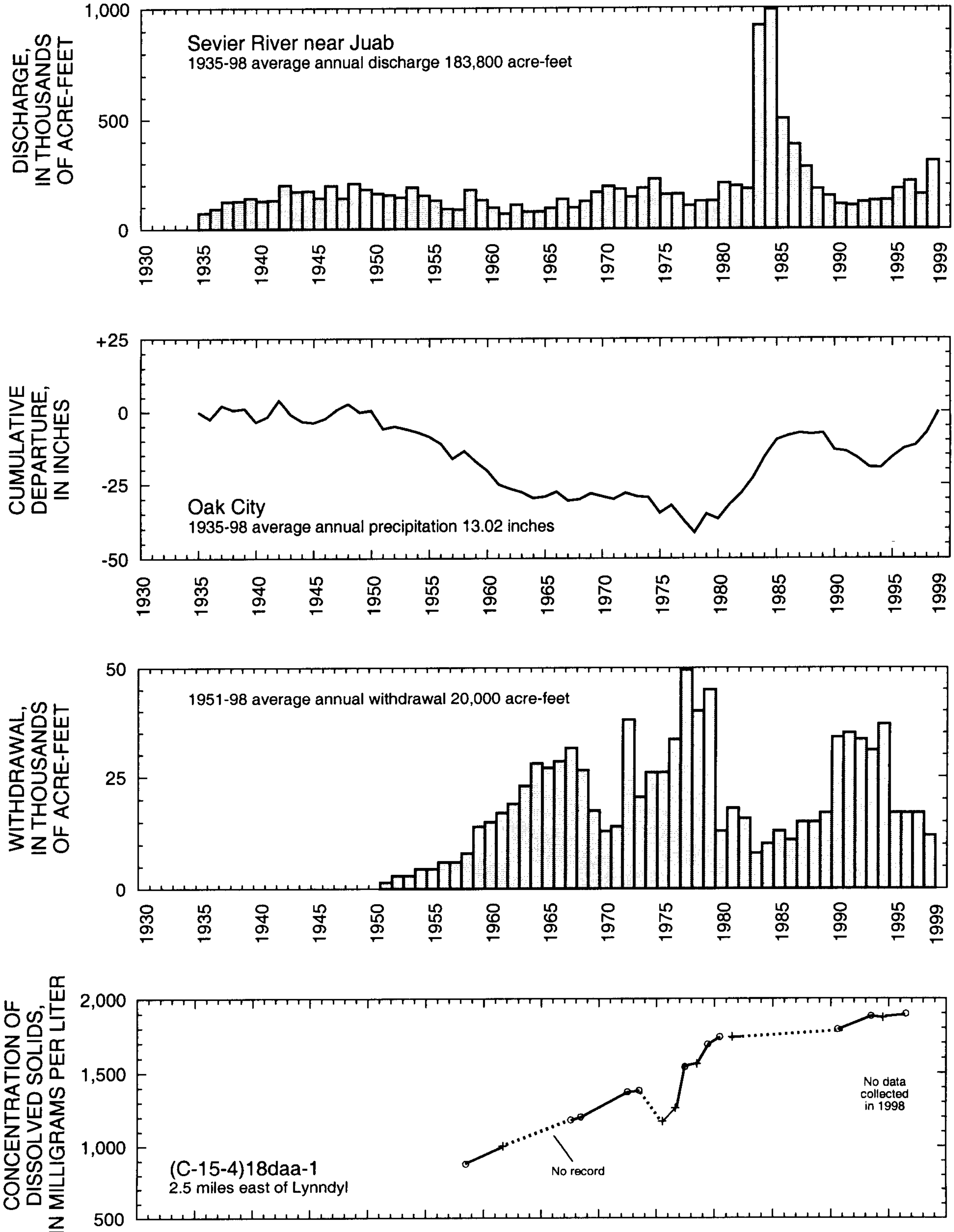


Figure 19. Relation of water level in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from average annual precipitation at Oak City, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1—Continued.

CENTRAL SEVIER VALLEY

By B.A. Slaugh

The central Sevier Valley is in south-central Utah, surrounded by the Sevier, Wasatch, and Gunnison Plateaus to the east and the Tushar Mountains, Valley Mountains, and Pahvant Range to the west. Altitude ranges from 5,100 feet on the valley floor at the north end of the valley near Gunnison to about 12,000 feet in the Tushar Mountains.

Total estimated withdrawal of water from wells in central Sevier Valley in 1998 was about 20,000 acre-feet, which is the same amount that was reported for 1997 and 1,000 acre-feet more than the average annual withdrawal for 1988-97 (tables 2 and 3).

The location of wells in the central Sevier Valley in which the water level was measured during March 1999 is shown in figure 20. The relation of the water level in selected wells to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 21. Long-term hydrographs for selected wells in the central Sevier Valley show that March water levels generally rose from about 1978 to 1985, declined from 1985 to about 1993, and have been stable or rising slightly since 1993. Water-level rises during 1978-85 probably resulted from greater-than-average precipitation during the same period and recharge from the Sevier River.

Discharge of the Sevier River at Hatch in 1998 was about 128,200 acre-feet. This is about 60,900 acre-feet more than the 67,300 acre-feet for 1997 and about 48,200 acre-feet more than the 1940-98 average annual discharge.

Precipitation at Richfield was 10.13 inches in 1998, which is 1.97 inches more than the 1950-98 average annual precipitation and 0.87 inch more than in 1997. Concentration of dissolved solids in water from well (C-23-2)15dcb-4 decreased from about 600 milligrams per liter to about 400 milligrams per liter during 1987-95, which was the concentration during 1955-59. The calculated concentration of dissolved solids for 1998 was 410 milligrams per liter.

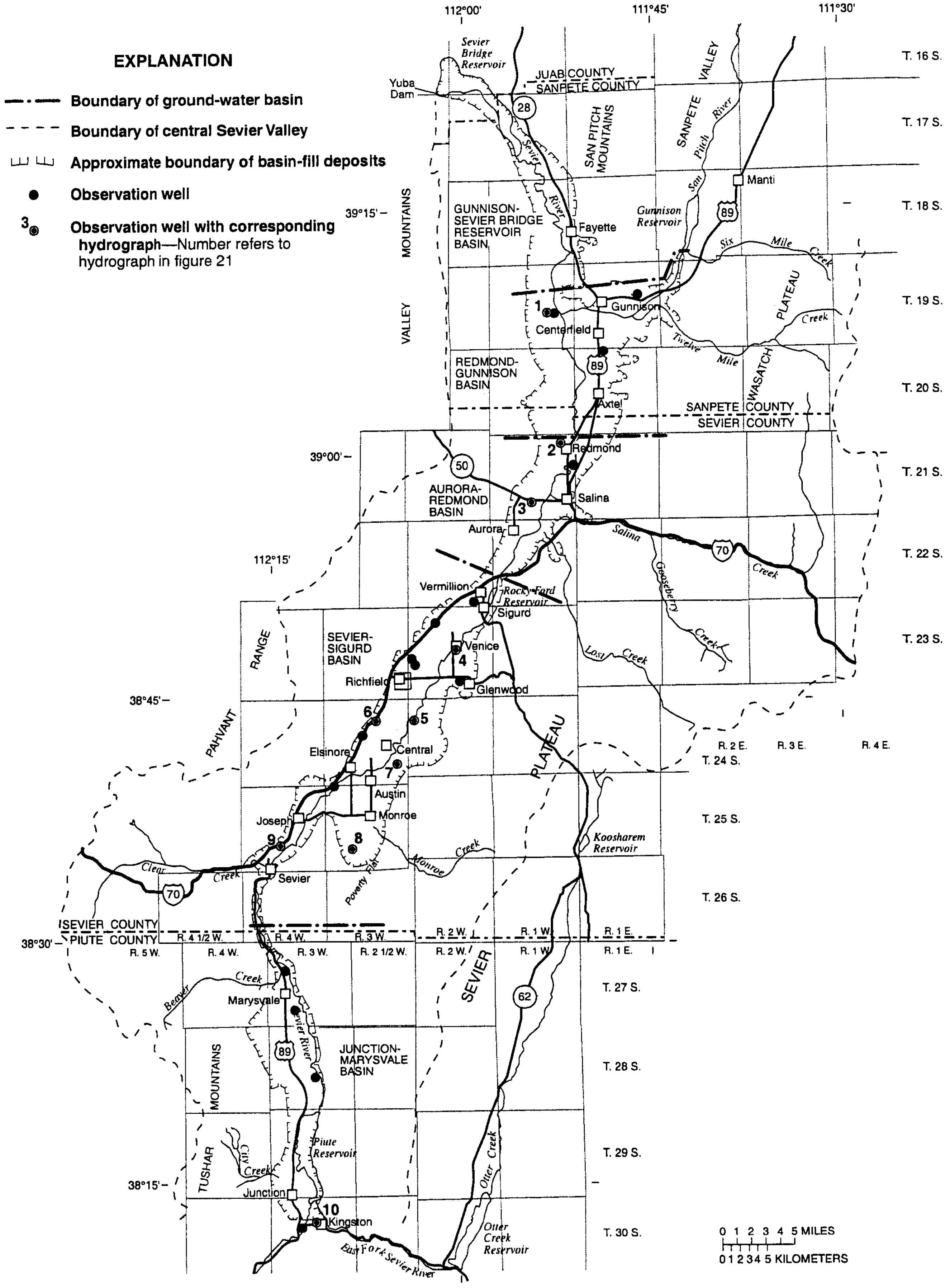


Figure 20. Location of wells in central Sevier Valley in which the water level was measured during March 1999.

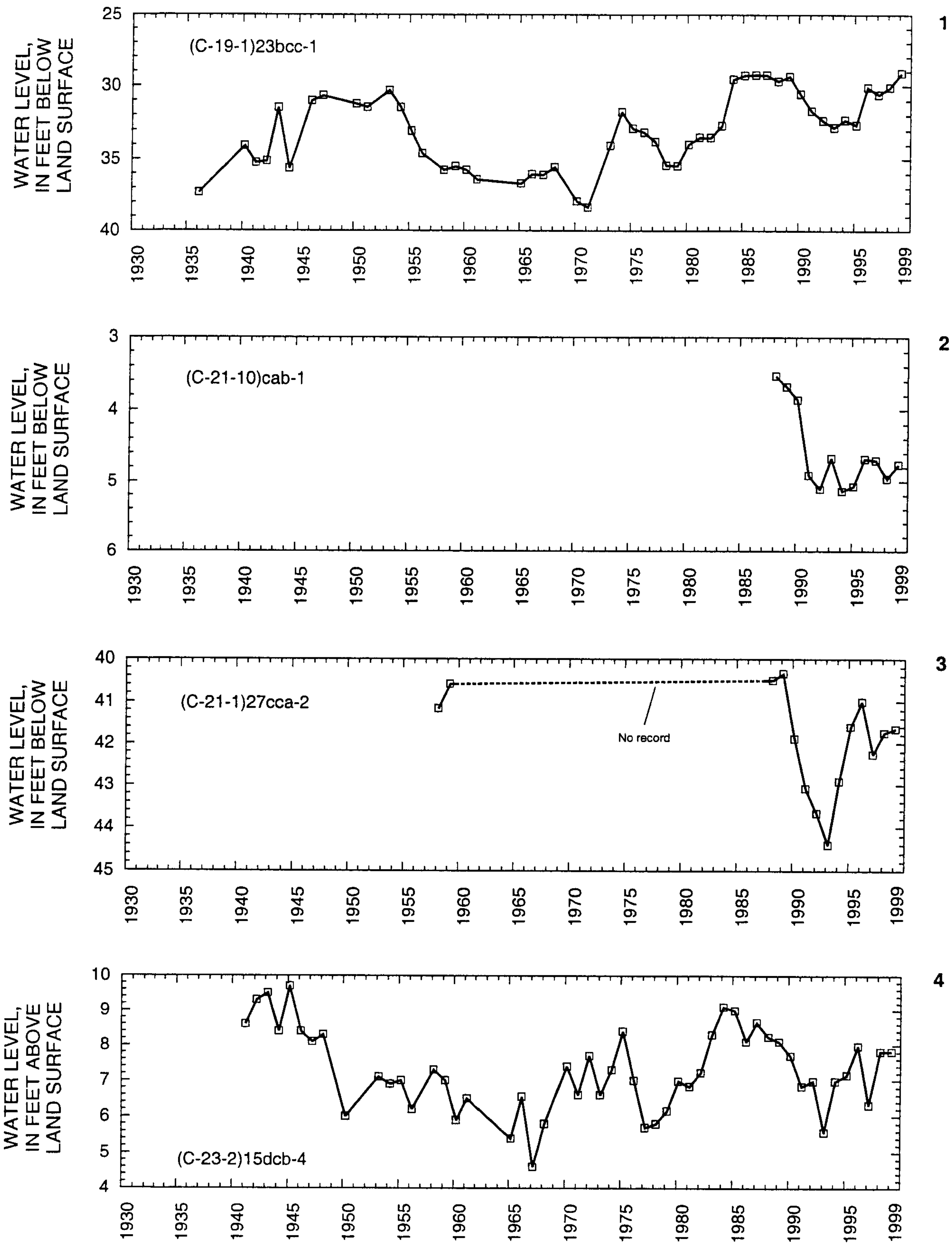


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

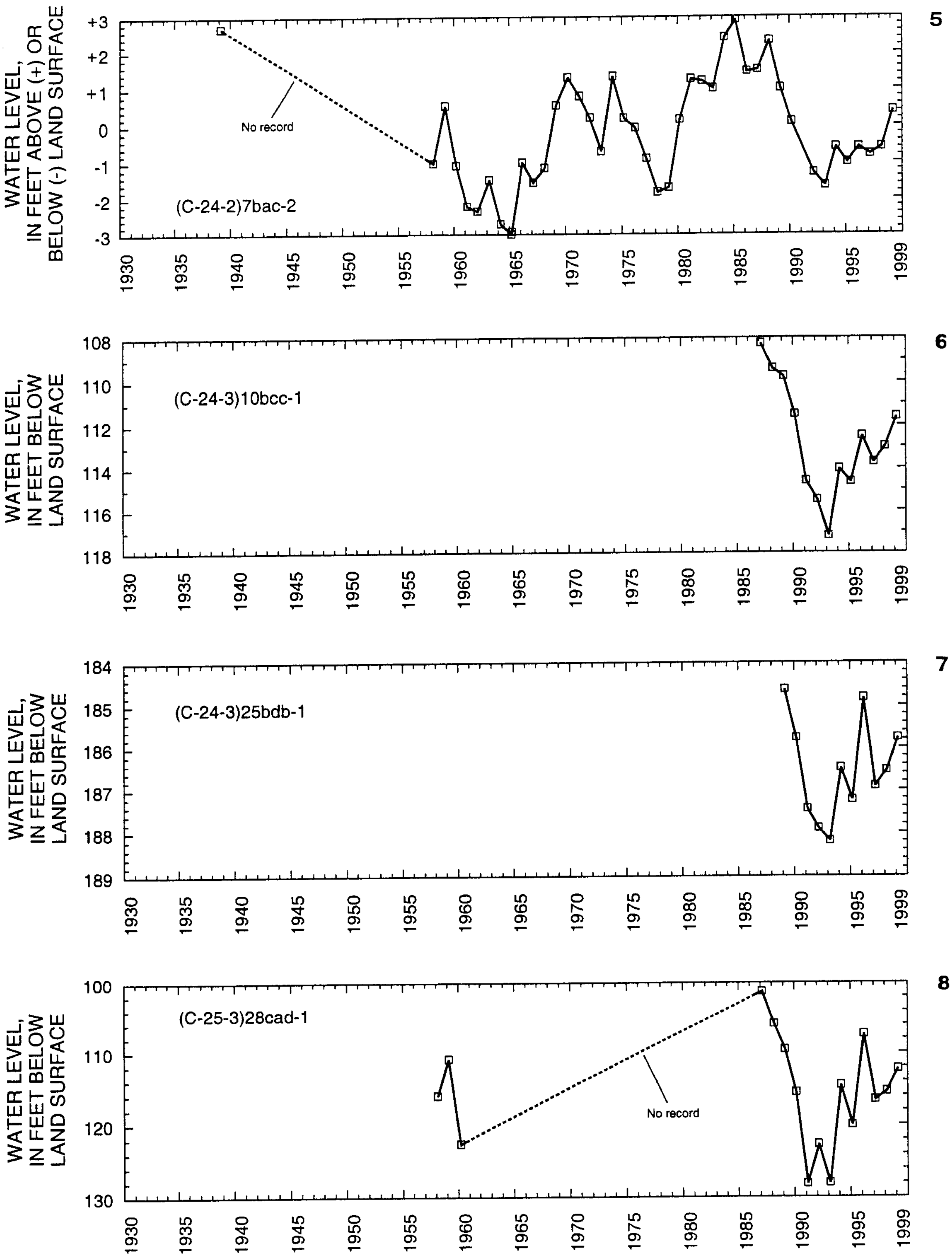
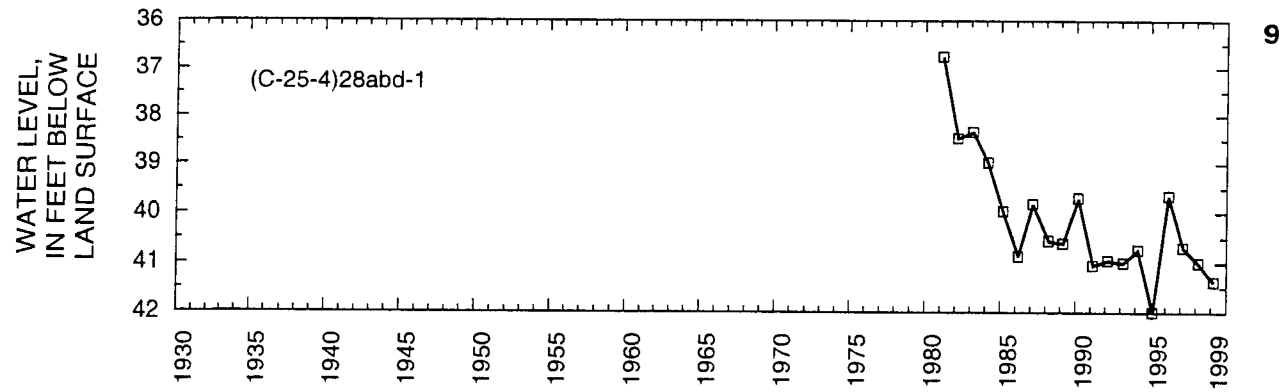


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.



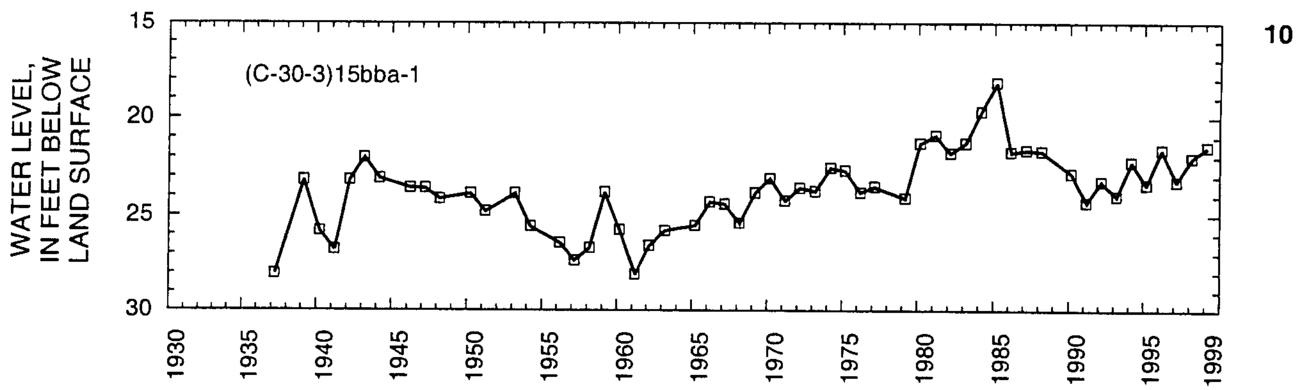


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.

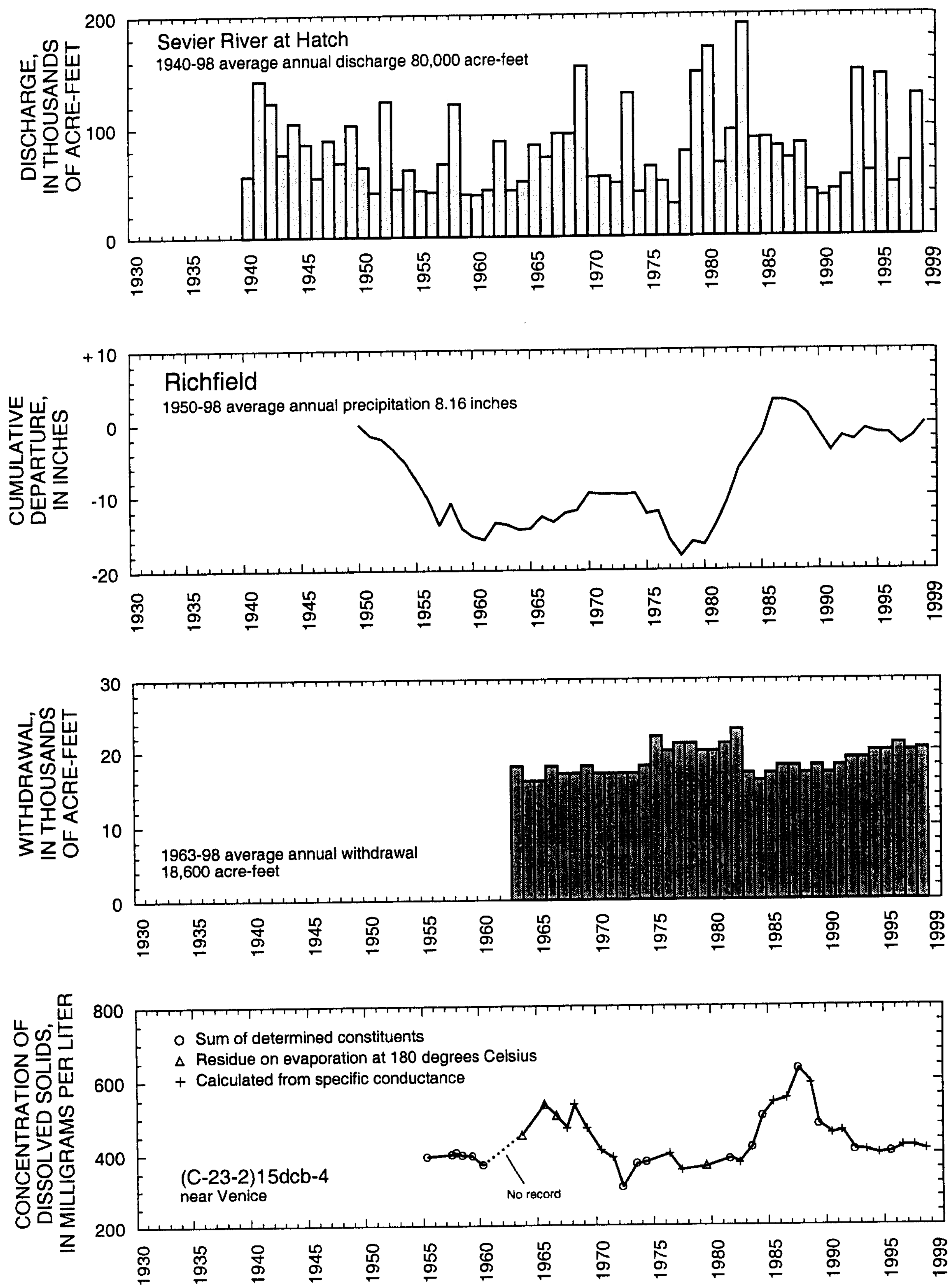


Figure 21. Relation of water level in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at Richfield, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.

PAHVANT VALLEY

By R.L. Swenson

Pahvant Valley, in southeast Millard County, extends from the vicinity of McCornick on the north to Kanosh on the south, from the Pahvant Range and Canyon Mountains on the east and northeast to a low basalt ridge on the west. The area of the valley is about 300 square miles, and water drains to the valley from about 500 square miles of the mountainous terrain. The valley is undrained on the surface south of the southern edge of T. 20 S.; north of this line, the surface is an undulating plain covered with sand dunes from which there is little or no surface drainage.

Total estimated withdrawal of water from wells in Pahvant Valley in 1998 was about 66,000 acre-feet, which is 1,000 acre-feet less than was reported in 1997 and 14,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3). Withdrawal for irrigation decreased by 1,800 acre-feet to 64,400 acre-feet from 1997 to 1998, primarily as a result of greater-than-average precipitation and availability of surface water. Geothermal power generation withdraws 550 acre-feet and is reported as industrial withdrawal. Total estimated withdrawal has fluctuated during the last 10 years, depending on the amount and timing of precipitation.

The location of wells in Pahvant Valley in which the water level was measured during March 1999 is shown in figure 22. The relation of the water level in selected wells to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 23. Water levels generally declined in the extreme northern and southern ends of the valley but rose throughout most of the remainder of the valley from March 1998 to March 1999. The greatest decline, about 5 feet, occurred in a well in Holden and in a well about 1.5 miles southwest of Holden.

The greatest rise, about 19 feet, occurred in a well about 1 mile north of Kanosh and in a well about 1 mile west of Holden. Increased withdrawal for irrigation from the early 1950s to about 1981 resulted in water-level declines of more than 50 feet in some areas of Pahvant Valley. Water levels rose sharply from 1983 to 1985 because of greater-than-average precipitation and decreased withdrawal for irrigation. By 1986, the water level in many wells was higher than the predevelopment water level. Water levels generally have declined since the mid- to late 1980s.

Precipitation at Fillmore during 1998 was 19.82 inches, which is 4.73 inches more than the average annual precipitation for 1931-98 and 1.43 inches more than in 1997.

The concentration of dissolved solids in water from wells near Flowell and west of Kanosh is shown in figure 23. The concentration of dissolved solids in water from well (C-21-5)7cdd-3, northwest of Flowell, has shown little change since 1983. The concentration of dissolved solids in water from well (C-23-6)21bdd-1, west of Kanosh, generally has increased since the late 1950s.

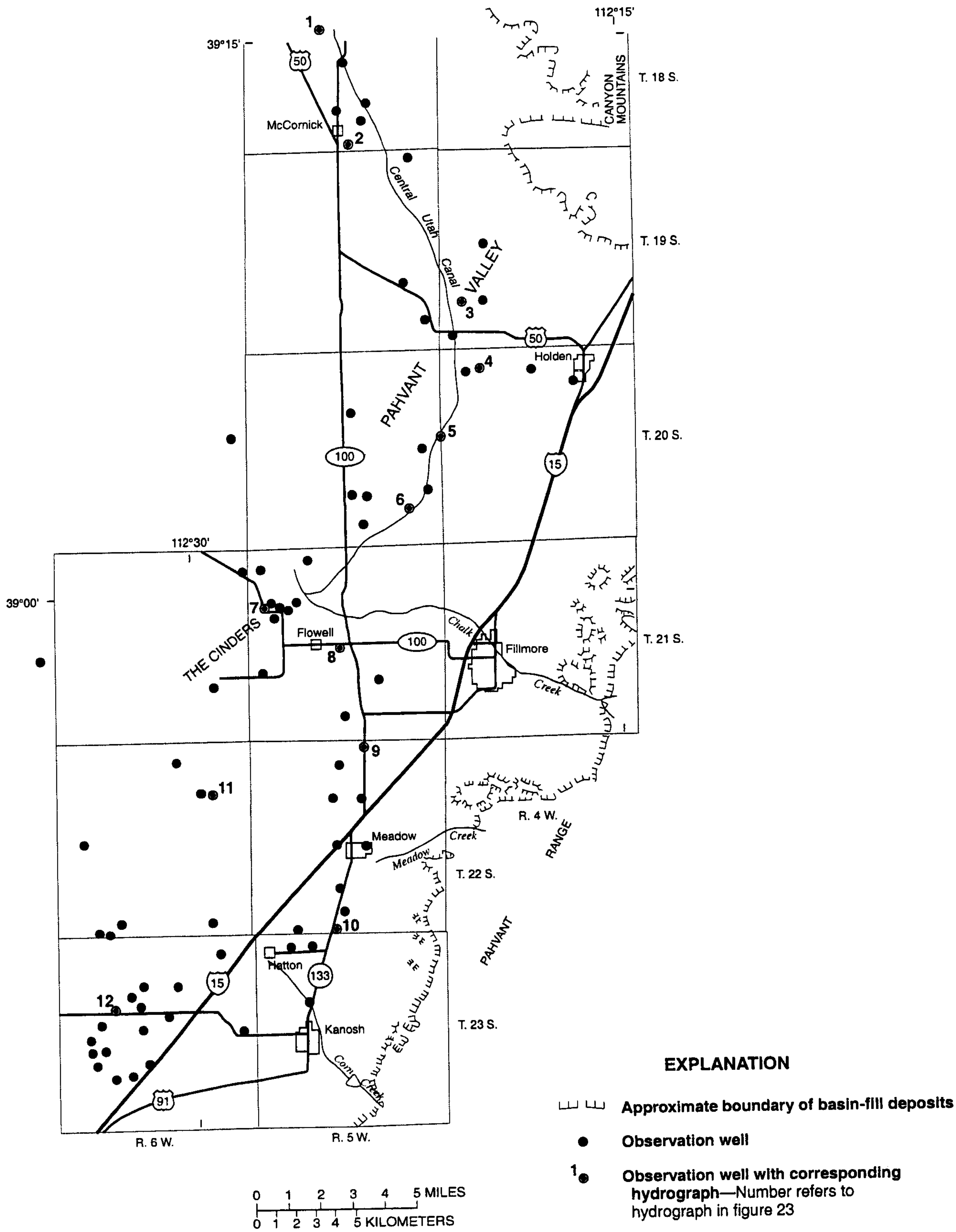


Figure 22. Location of wells in Pahvant Valley in which the water level was measured during March 1999.

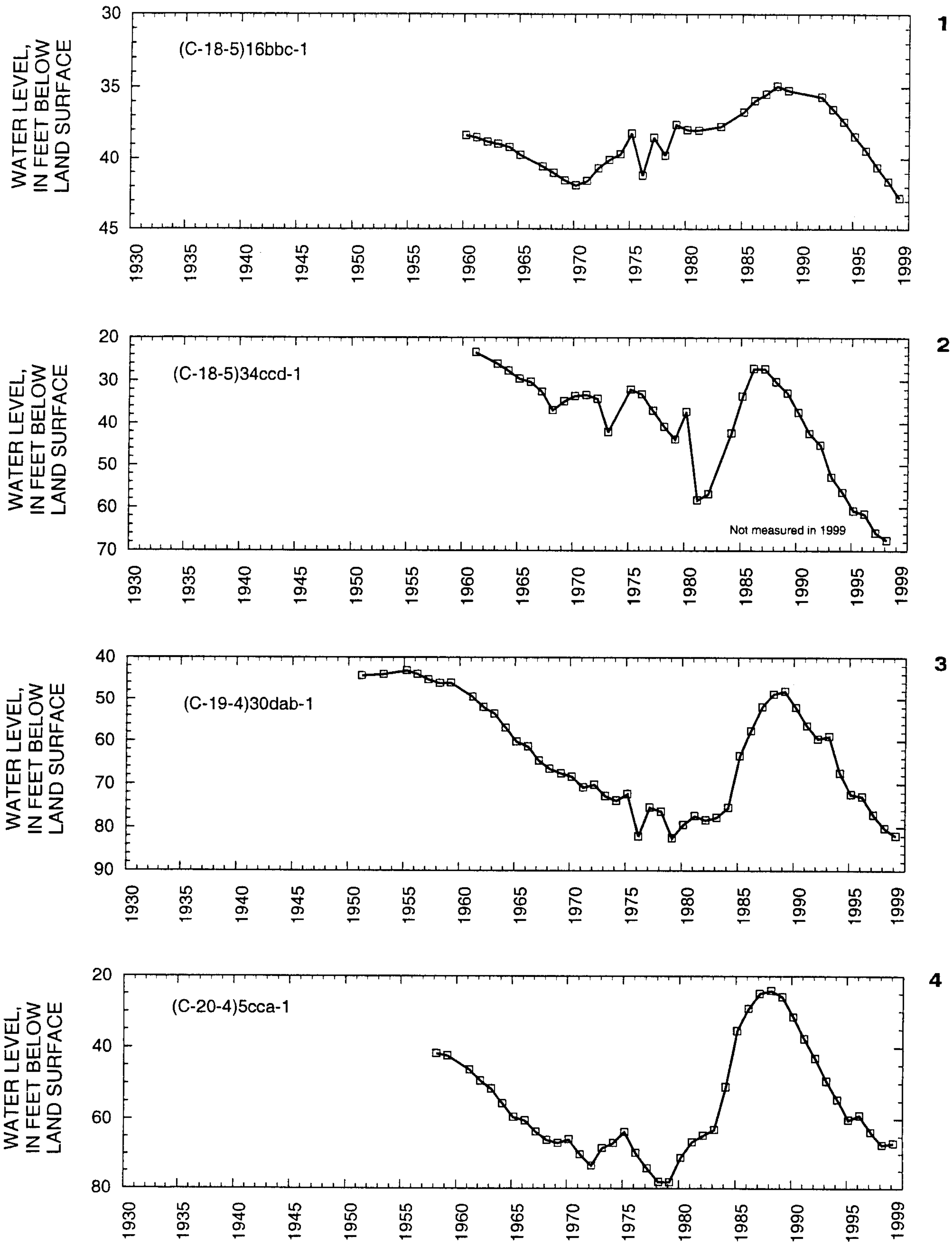


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

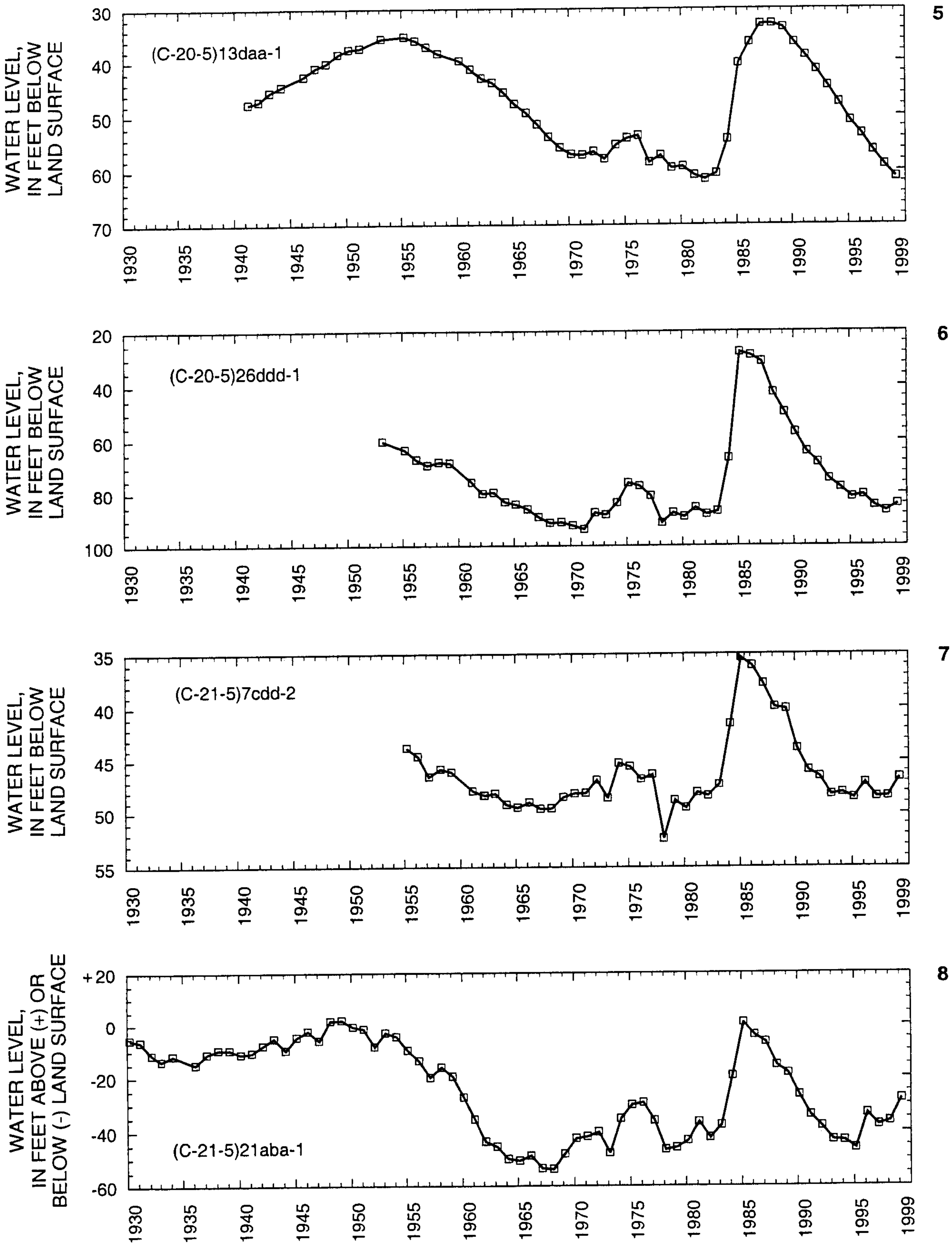


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

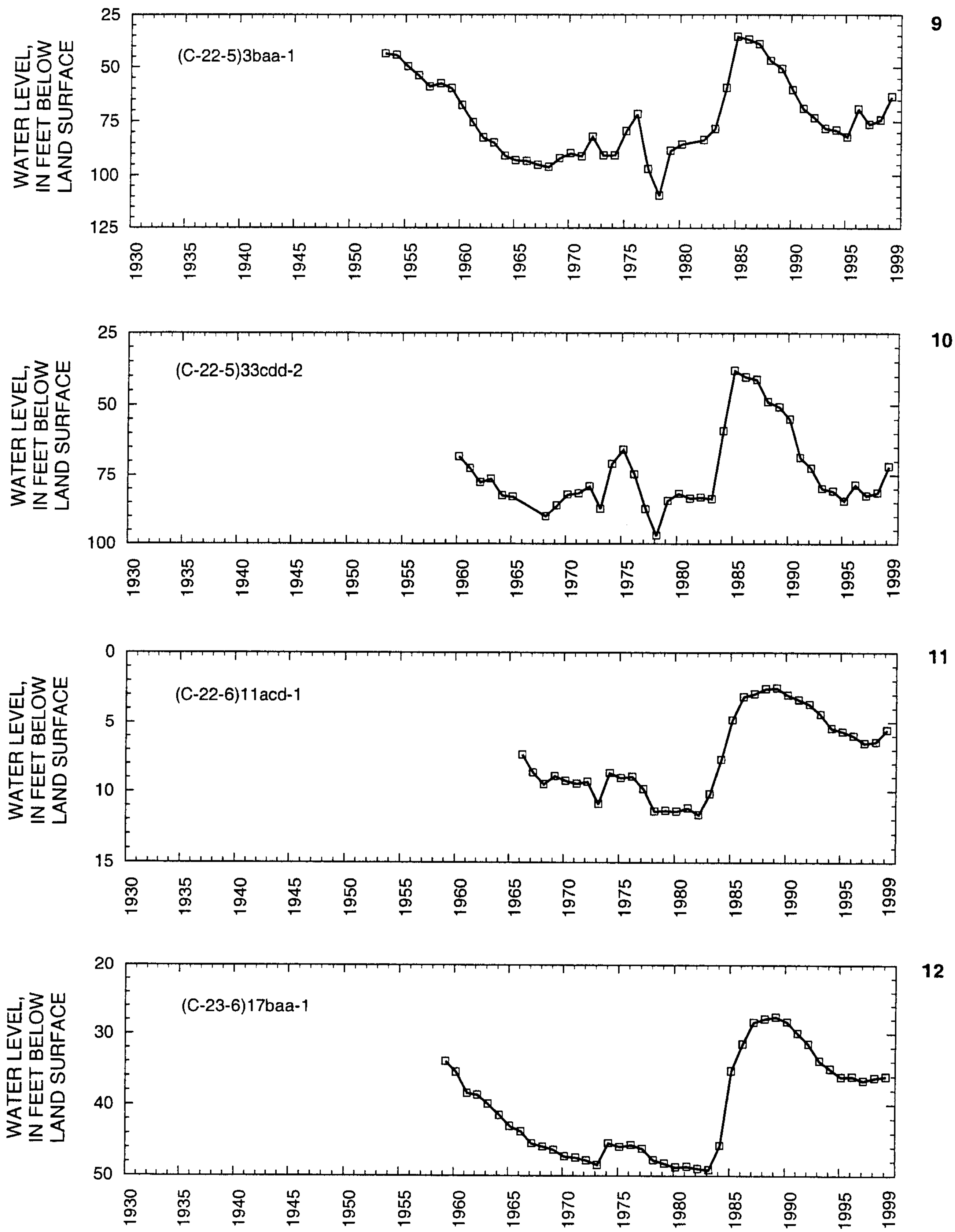


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

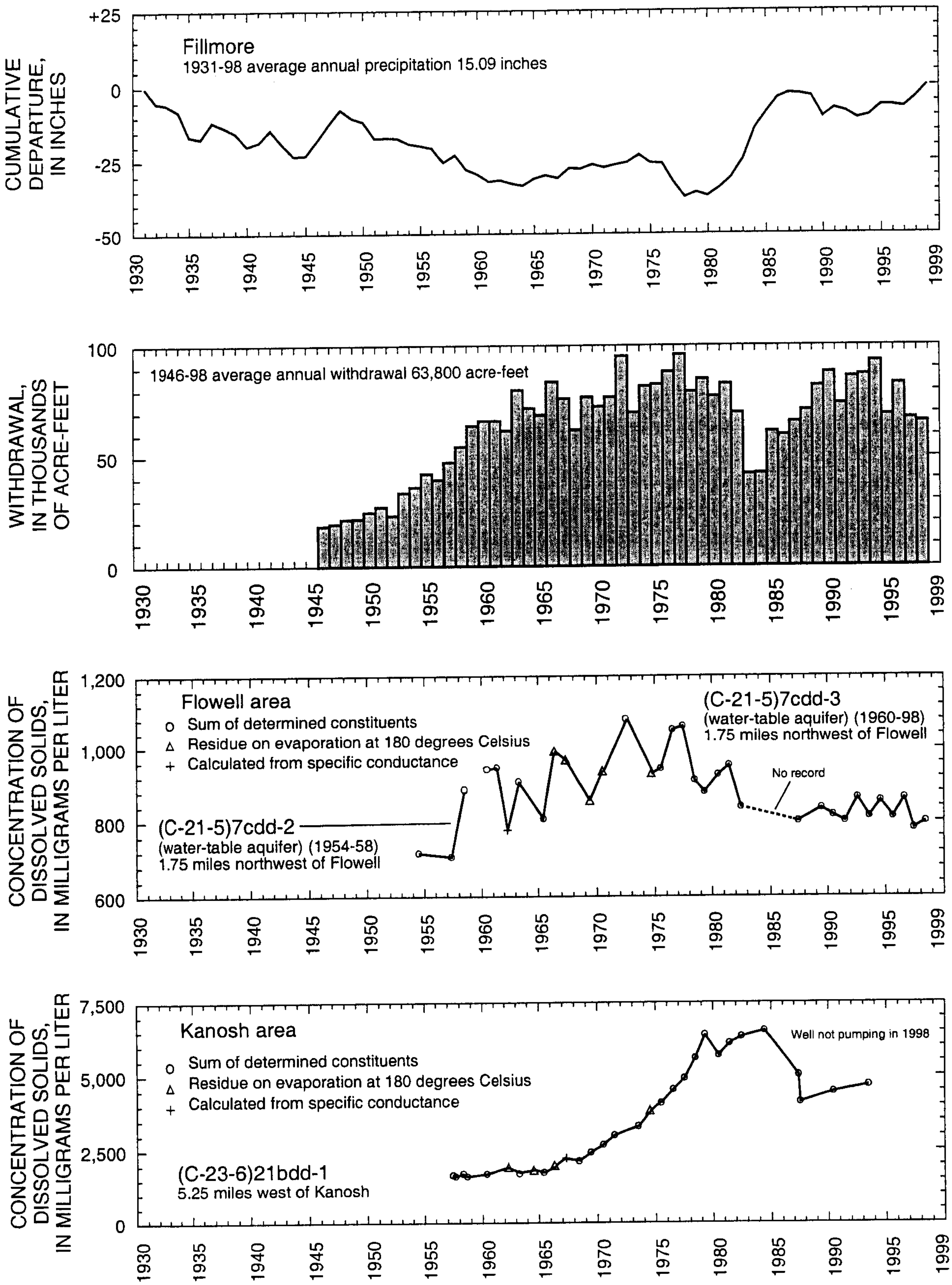


Figure 23. Relation of water level in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells—Continued.

CEDAR VALLEY, IRON COUNTY

By J.H. Howells

Cedar Valley is in eastern Iron County in southwestern Utah. The valley is about 170 square miles in area and is bounded on the east by the Markagunt Plateau, on the west and southwest by Granite Mountain and the Harmony Hills, on the south by a low ground- and surface-water divide near Kanarraville, and on the north by the Black Mountains. Ground water in Cedar Valley occurs in unconsolidated deposits, mostly under water-table conditions. The principal source of recharge to aquifers is water from Coal Creek, which seeps directly from the stream channel into the ground after being diverted for irrigation.

Total estimated withdrawal of water from wells in Cedar Valley in 1998 was about 36,000 acre-feet, which is 2,000 acre-feet more than was reported for 1997 and 5,000 acre-feet more than the average annual withdrawal for 1988-97 (tables 2 and 3).

The location of wells in which the water level was measured during March 1999 is shown in figure 24. The relation of the water level in selected wells to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 25.

March water levels rose from 1998 to 1999 in most parts of Cedar Valley for which data are available. The largest rises, about 6 to 7 feet, occurred in three wells north and west of Cedar City. Water levels declined in three wells on the western edge of the valley, and in one well north of Enoch. The largest decline, about 3 feet, occurred in a well about 1 mile west of Quichapa Lake.

The rises probably resulted from increased recharge from greater-than-average precipitation and much-greater-than-average streamflow in 1998. Declines might have resulted from locally increased withdrawals.

Long-term hydrographs for selected wells in the northern part of Cedar Valley show that March water levels generally have declined since measurements began. Water levels in the central and southern parts of the valley generally rose in the mid-1980s and generally have declined since 1989.

Precipitation at Cedar City Federal Aviation Administration Airport in 1998 was 12.86 inches, which is 2.14 inches more than for 1997 and 2.02 inches more than the average annual precipitation for 1951-98. The discharge of Coal Creek was about 47,600 acre-feet in 1998, which is 28,600 acre-feet more than the 19,000 acre-feet for 1997, and 23,300 acre-feet more than the average annual discharge for 1936 and 1939-98. The concentrations of dissolved solids in water from wells (C-35-11)31dbb-1, (C-37-12)23acb-1, and (C-37-12)23abd-1 have ranged between 300 and 600 milligrams per liter.

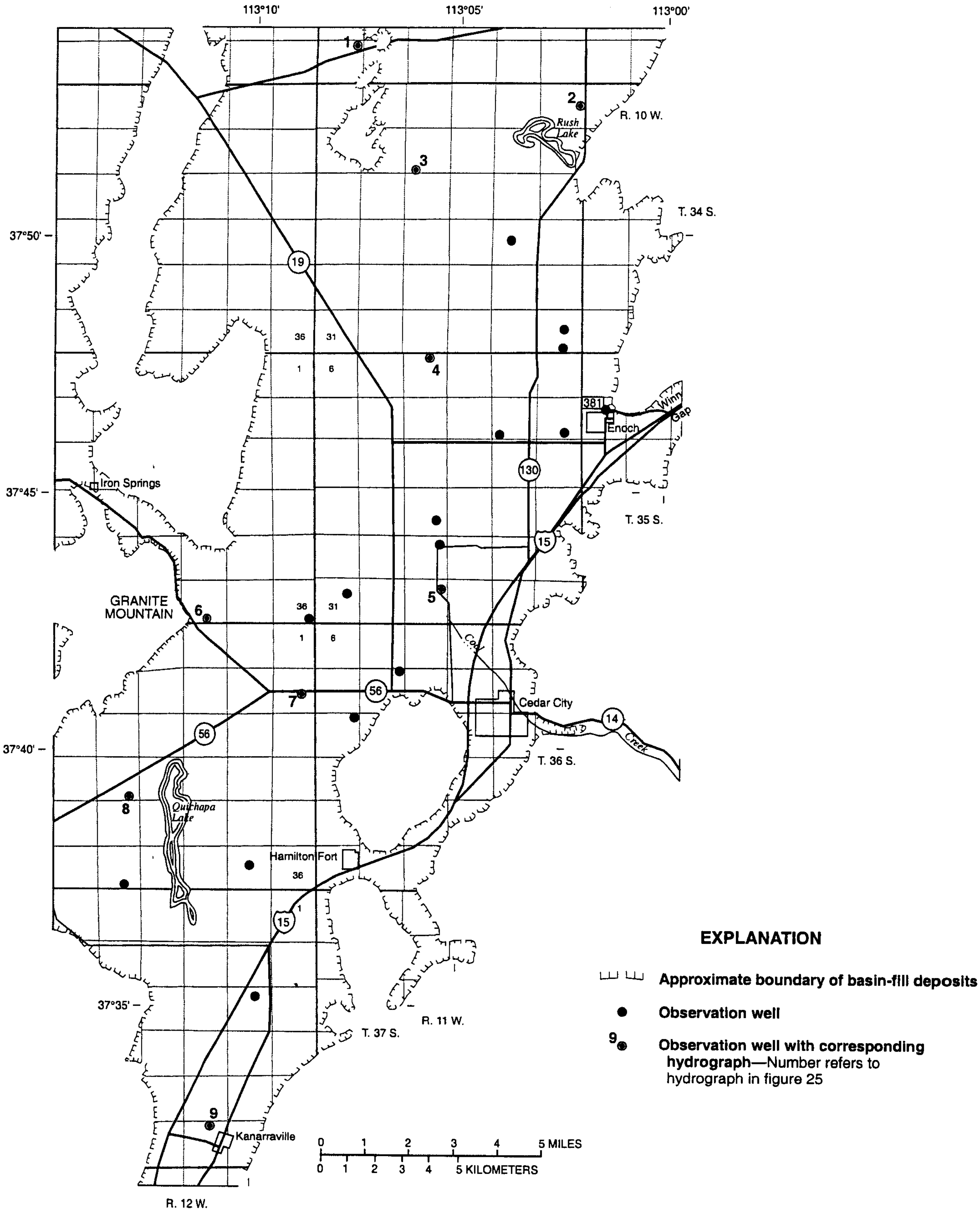


Figure 24. Location of wells in Cedar Valley, Iron County, in which the water level was measured during March 1999.

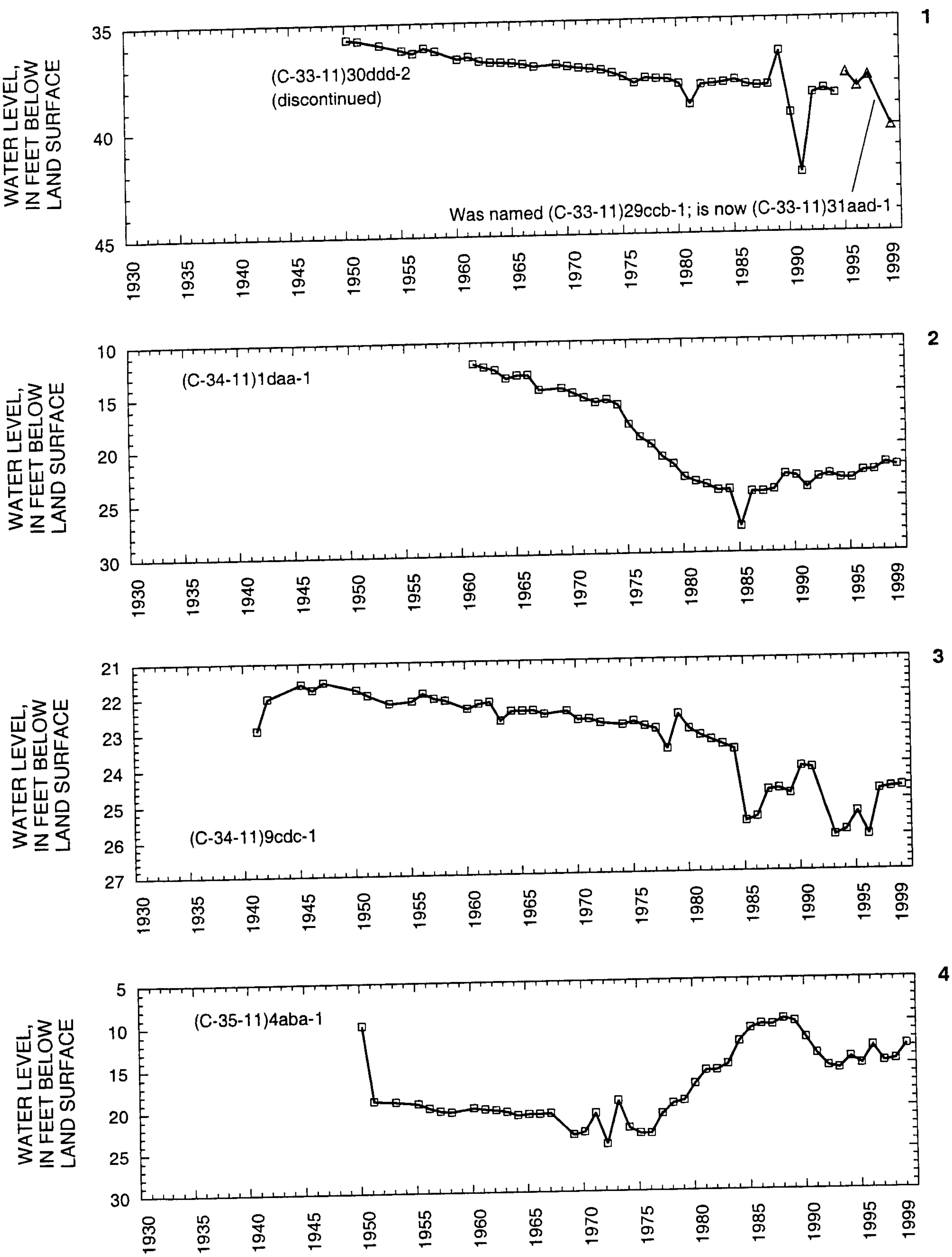


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells.

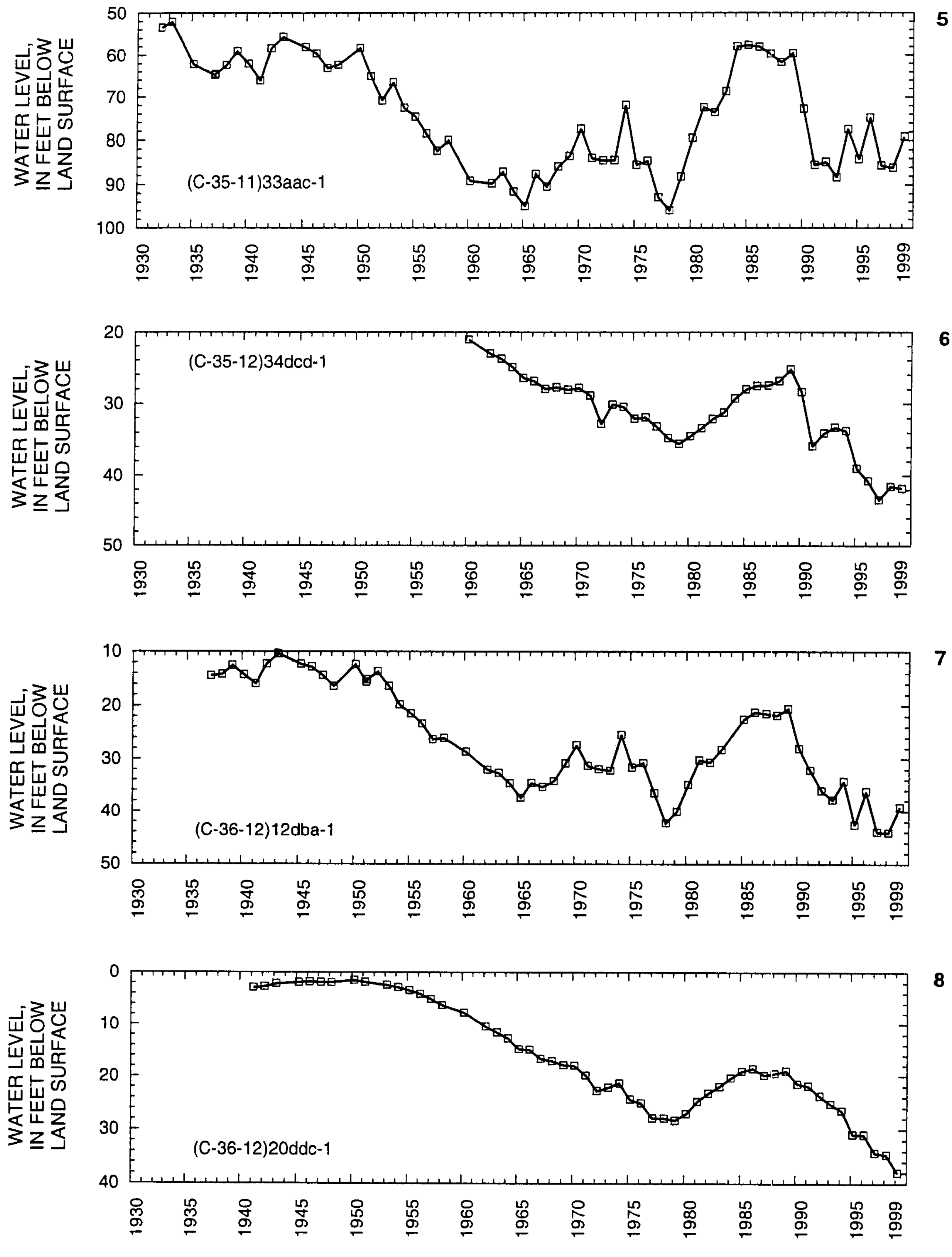


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells–Continued.

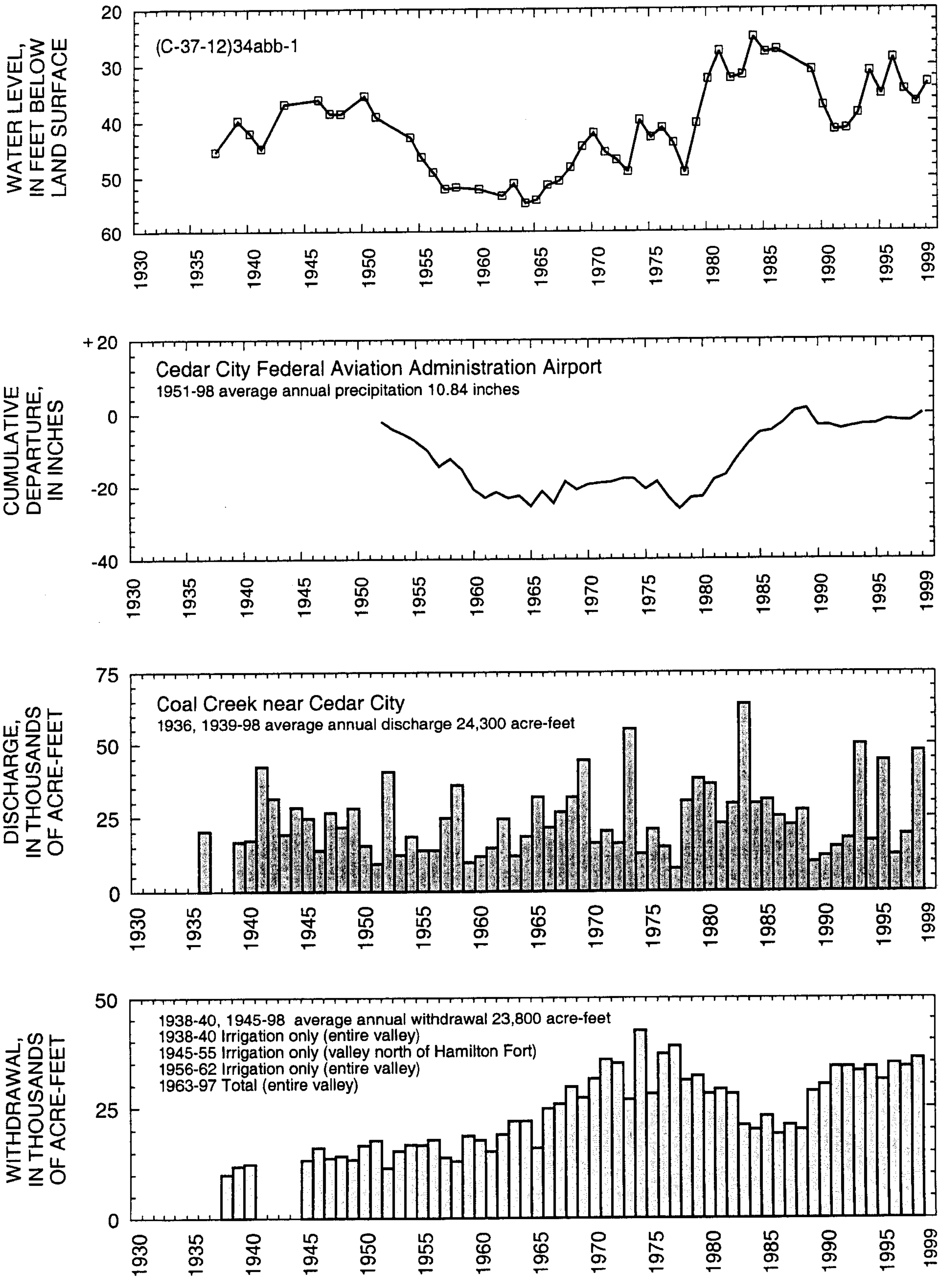
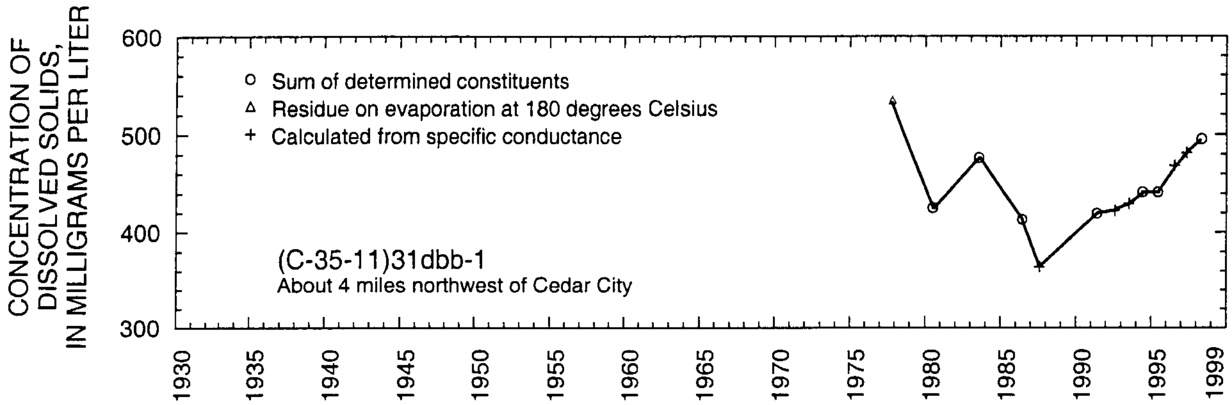


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells–Continued.



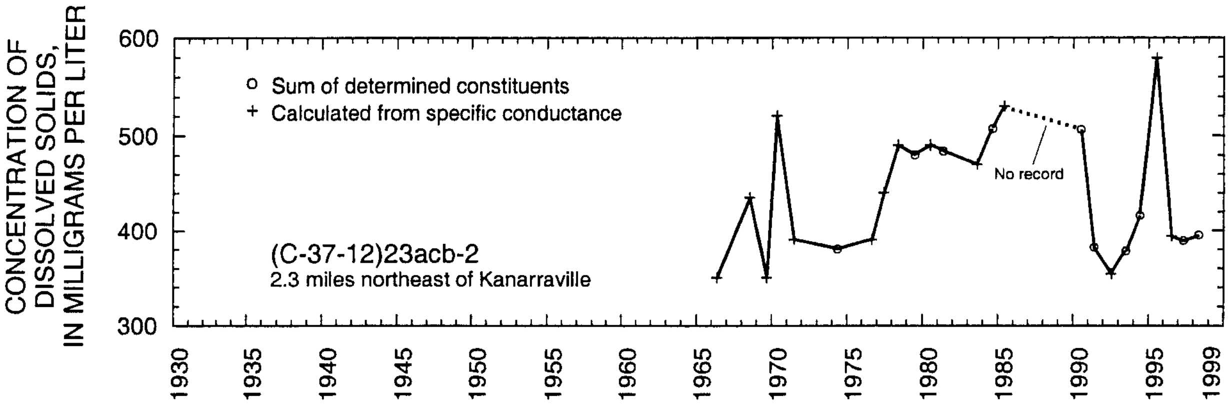


Figure 25. Relation of water level in selected wells in Cedar Valley, Iron County, to cumulative departure from average annual precipitation at Cedar City Federal Aviation Administration Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawal from wells, and to concentration of dissolved solids in water from selected wells–Continued.

PAROWAN VALLEY

By J.H. Howells

Parowan Valley is in northern Iron County in southwestern Utah. The valley is about 160 square miles in area and is bounded on the east and south by the Markagunt Plateau, on the west by the Red Hills, and on the north by the Black Mountains. Ground water occurs in unconsolidated deposits under both water-table and artesian conditions.

Total estimated withdrawal of water from wells in Parowan Valley in 1998 was about 28,000 acre-feet, which is about 3,000 acre-feet more than was reported in 1997 and the same as the average annual withdrawal for 1988-97 (tables 2 and 3).

The location of wells in Parowan Valley in which the water level was measured during March 1999 is shown in figure 26. The relation of the water level in selected wells to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 27.

March water levels rose from 1998 to 1999 in most parts of Parowan Valley for which data are available. The greatest rises, about 9 feet, occurred in wells north of Parowan and west of Paragonah. Declines of between 0 feet and 2 feet were measured in several wells in the north part of Parowan Valley. Rises probably resulted from greater-than-average precipitation in 1998. Declines probably resulted from increased withdrawals for irrigation in the north end of the valley.

March water levels in Parowan Valley generally have declined since the 1950s except for rises during 1973-74, 1983-85, and 1996-99. The sharp rise from 1983 to 1985 resulted from greater-than-average precipitation during the same period. The largest decline during 1986-95, about 90 feet, occurred in well (C-34-9)11bca-1, about 1 mile north of Parowan (fig. 27).

Precipitation at Parowan Power Plant in 1998 was 17.53 inches, which is 4.91 inches more than the average annual precipitation for 1935-98 and 2.92 inches more than in 1997. The concentration of dissolved solids in water from well (C-33-8)31ccc-1 has been relatively constant since 1988. Notable exceptions to the nearly constant trend occurred in 1973, 1974, and 1987.

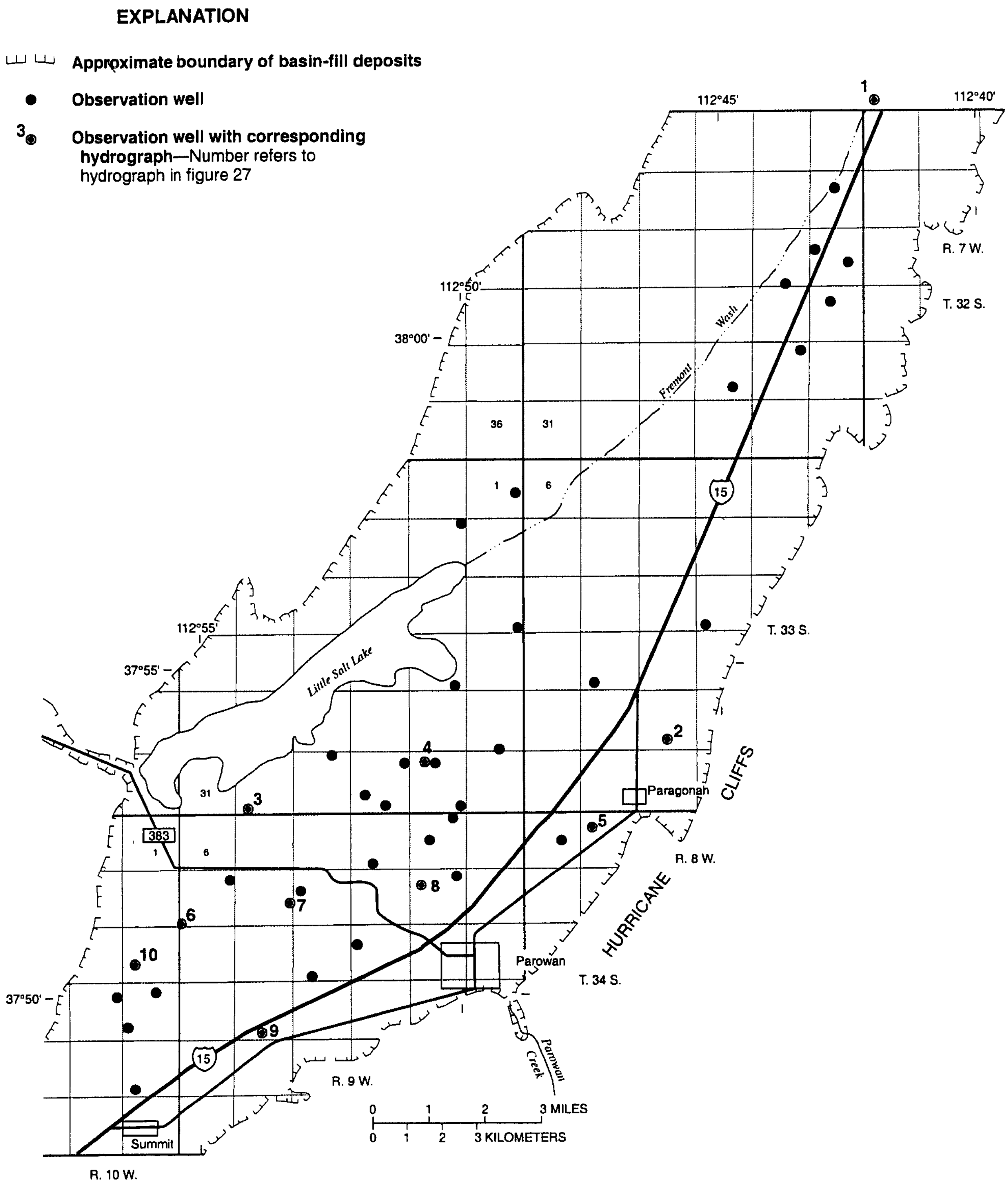


Figure 26. Location of wells in Parowan Valley in which the water level was measured during March 1999.

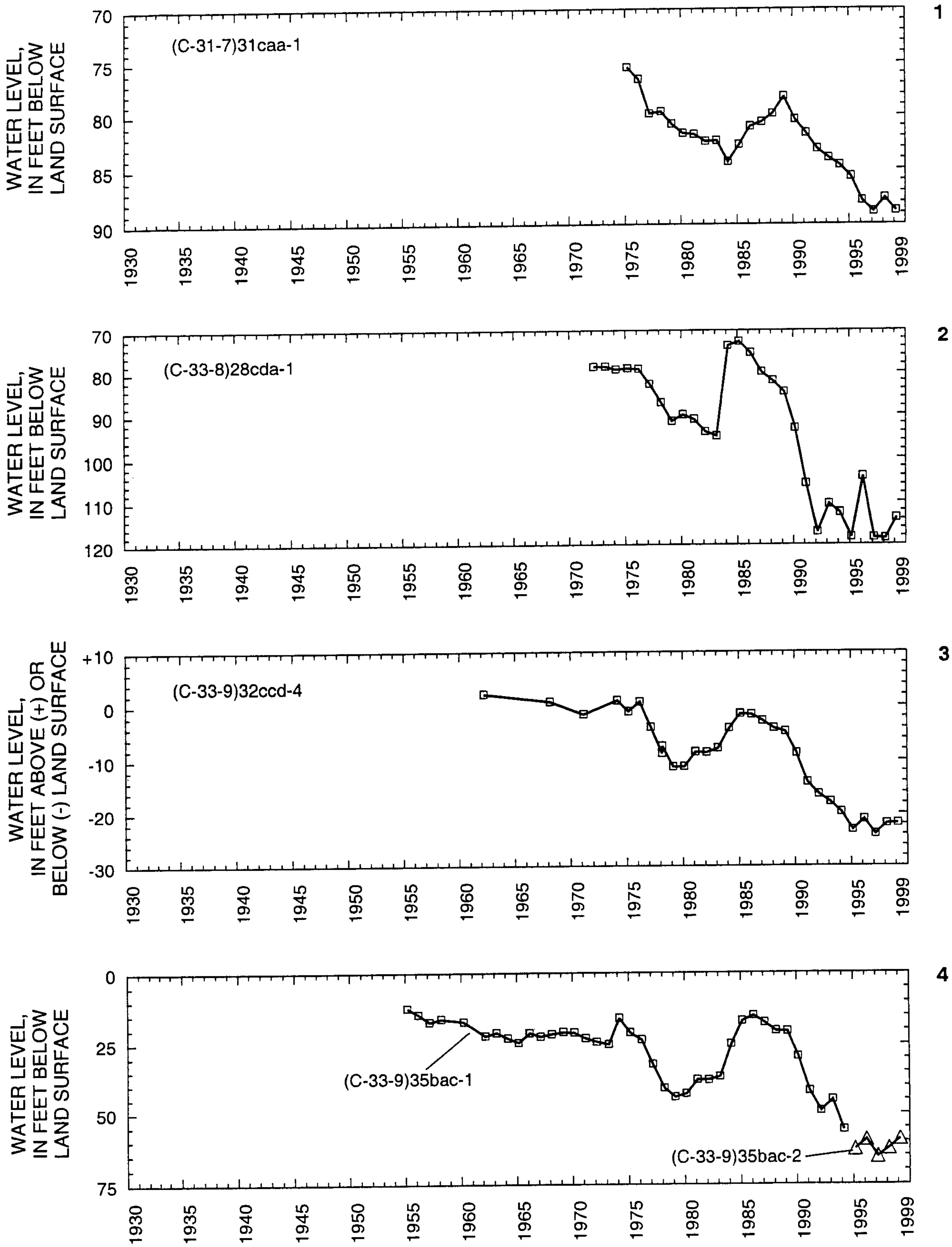


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Parowan Power Plant, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

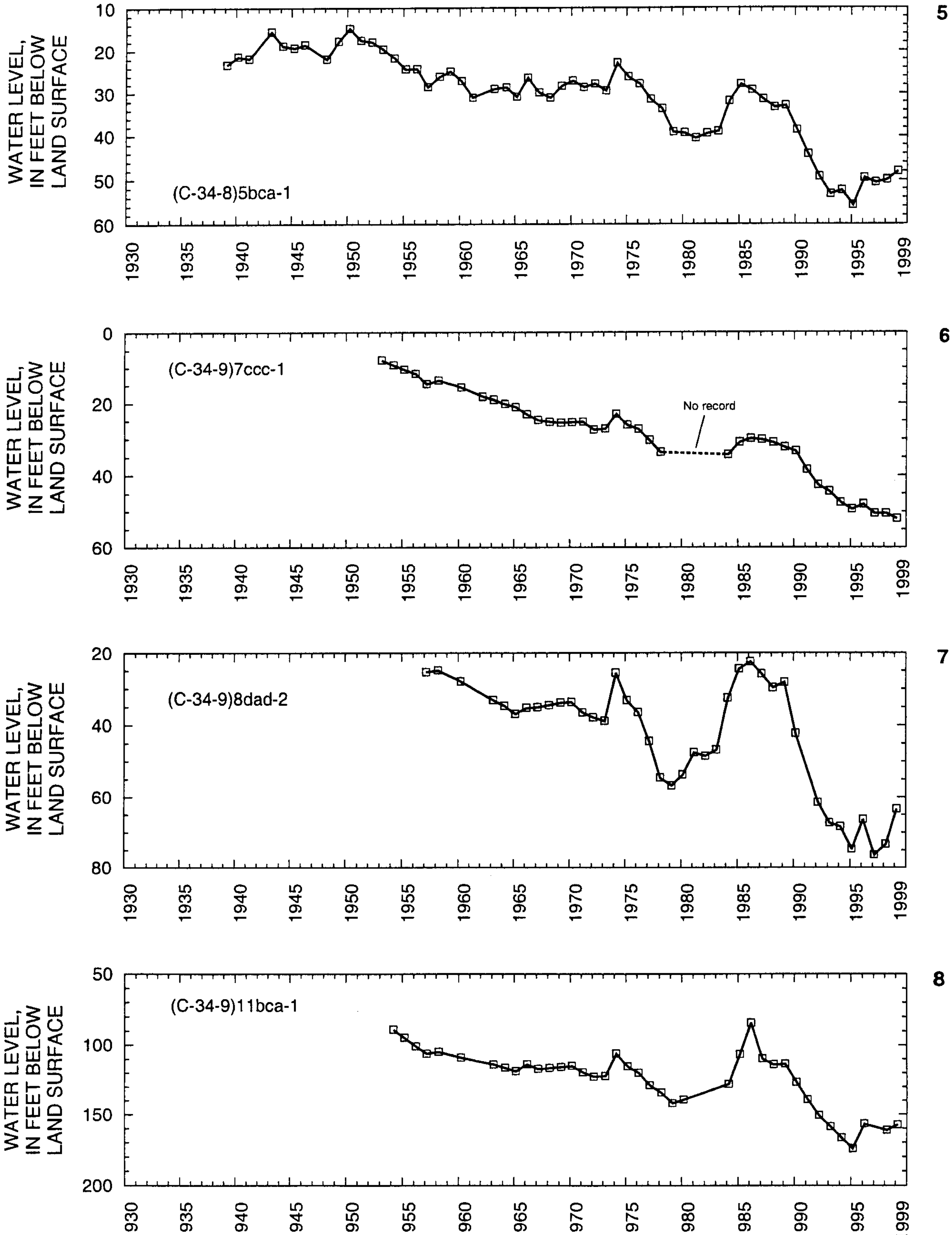
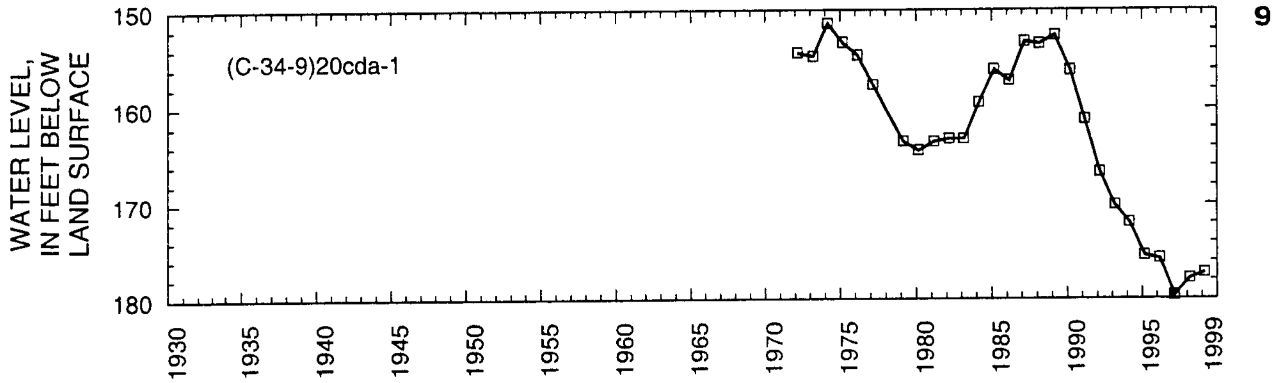


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Parowan Power Plant, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.



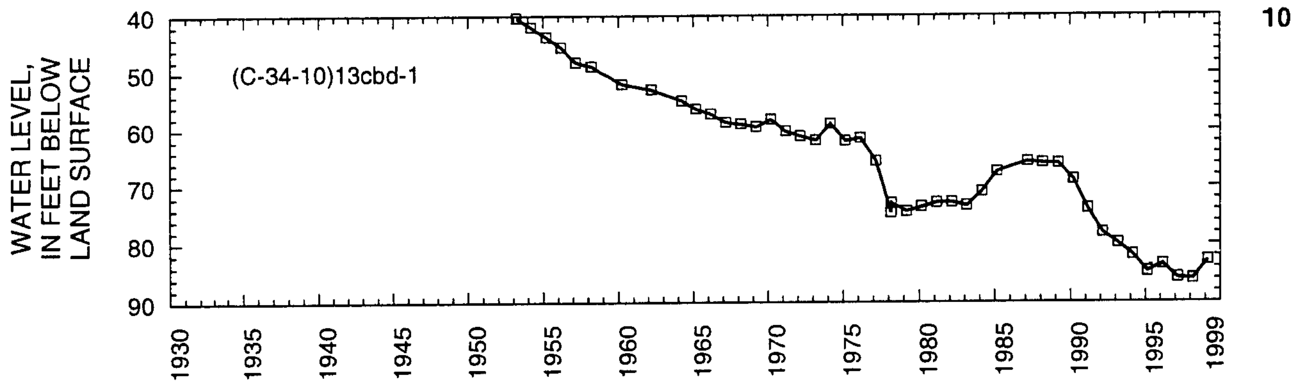


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Parowan Power Plant, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

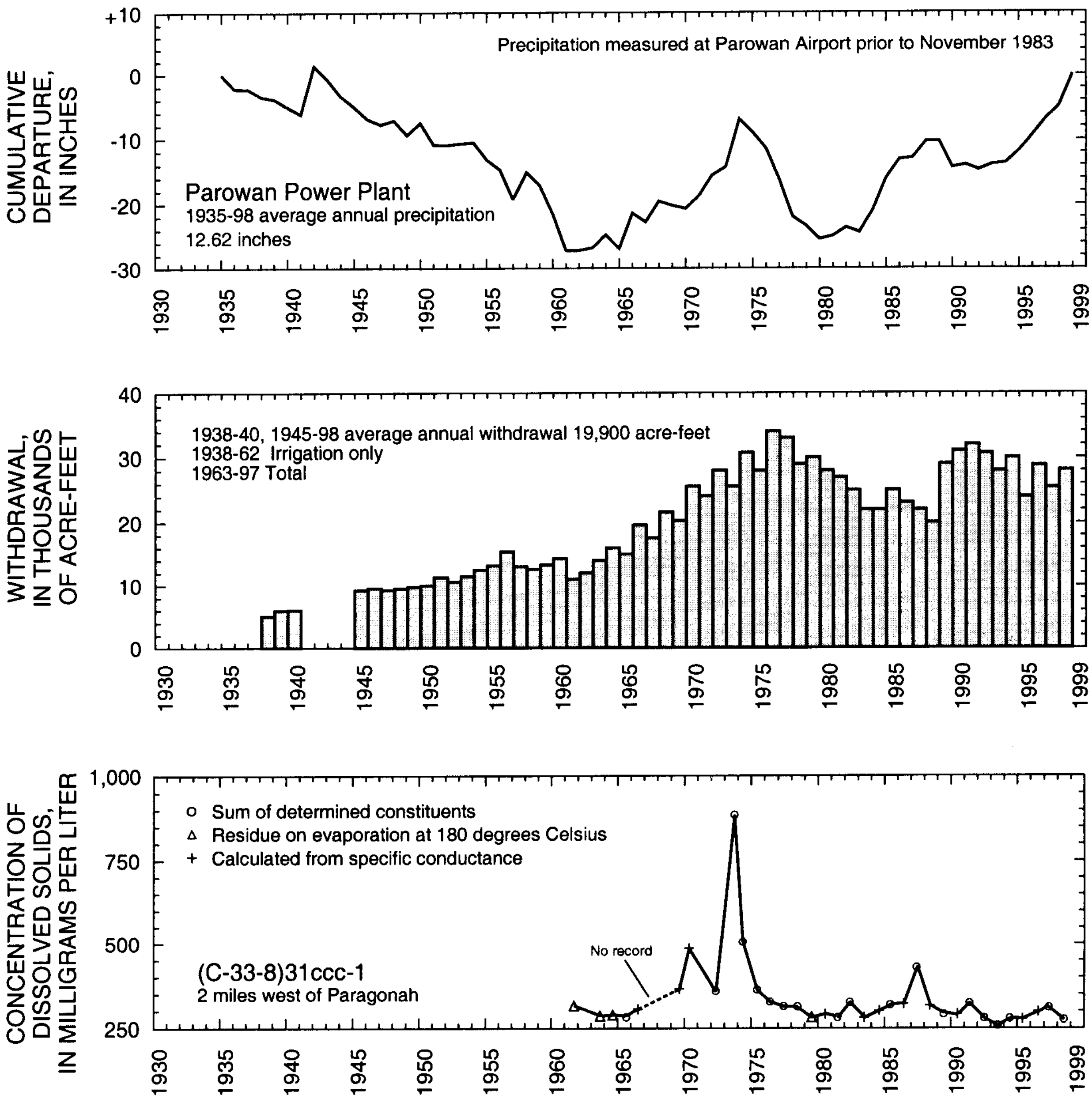


Figure 27. Relation of water level in selected wells in Parowan Valley to cumulative departure from average annual precipitation at Parowan Power Plant, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

ESCALANTE VALLEY

Milford Area

By B.A. Slaugh

The Milford area is in southwest Utah in parts of Millard, Beaver, and Iron Counties. It is bounded by drainage divides in the Cricket Mountains on the north, the Black Mountains on the south, the Mineral Mountains on the east, and the San Francisco Mountains and part of the Wah Wah Mountains on the west.

Total estimated withdrawal of water from wells in the Milford area of the Escalante Valley in 1998 was about 41,000 acre-feet, which is 11,000 acre-feet less than was reported for 1997 and 8,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3). The decrease in withdrawal resulted from increased availability of surface water for irrigation because of greater-than-average precipitation, which resulted in less demand for ground water.

The location of wells measured during March 1999 is shown in figure 28. The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1 is shown in figure 29.

Long-term hydrographs for selected wells in the Milford area show that water levels generally have declined since the early 1950s in the south-central Milford area in response to long-term increased withdrawal. Water-level rises during 1983-85 resulted from greater-than-average precipitation during 1982-85 and increased recharge from record flow in the Beaver River during 1983-84. Water levels generally have continued to decline since 1985. Water level in well (C-25-10)26caa-1, located 15 miles north of Milford, and well (C-30-13)34bba-1, located 23 miles southwest of Milford, show less than 2 feet of change since 1940. Water levels are stable in these areas because there is no withdrawal for irrigation.

Precipitation at Black Rock in 1998 was 13.41 inches, 1.13 inches more than for 1997 and 4.30 inches more than the 1952-98 average annual precipitation.

Discharge of the Beaver River in 1998 was about 51,100 acre-feet, which is 22,100 acre-feet more than the 1931-35 and 1938-98 average annual discharge. The concentration of dissolved solids in water from well (C-28-11) 25dcd-1 increased to about 2,000 milligrams per liter in 1983, and decreased to about 600 milligrams per liter in 1998. The long-term trend (1950 to present) indicates an increase from about 500 milligrams per liter to 1,500 milligrams per liter.

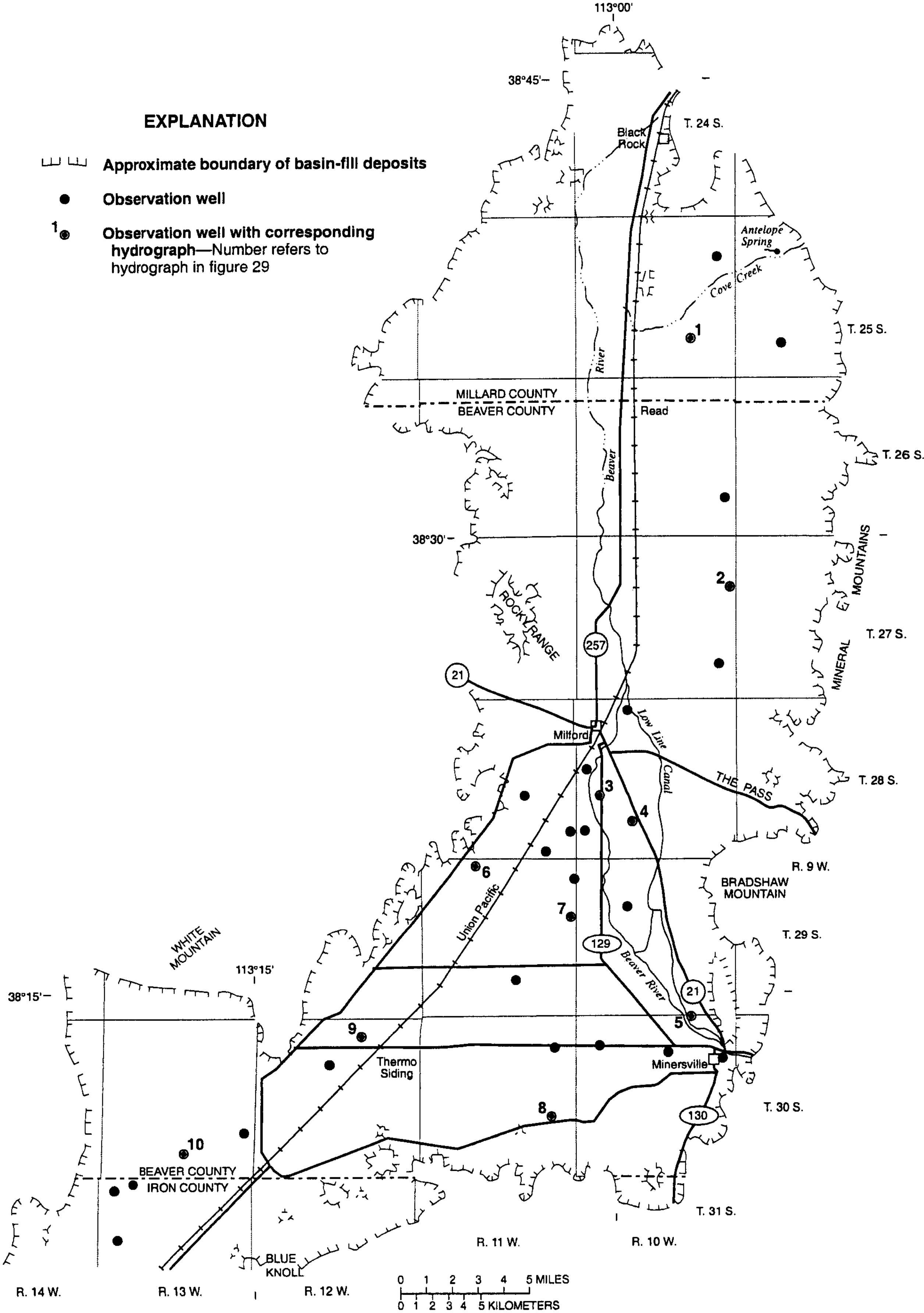


Figure 28. Location of wells in the Milford area in which the water level was measured during March 1999.

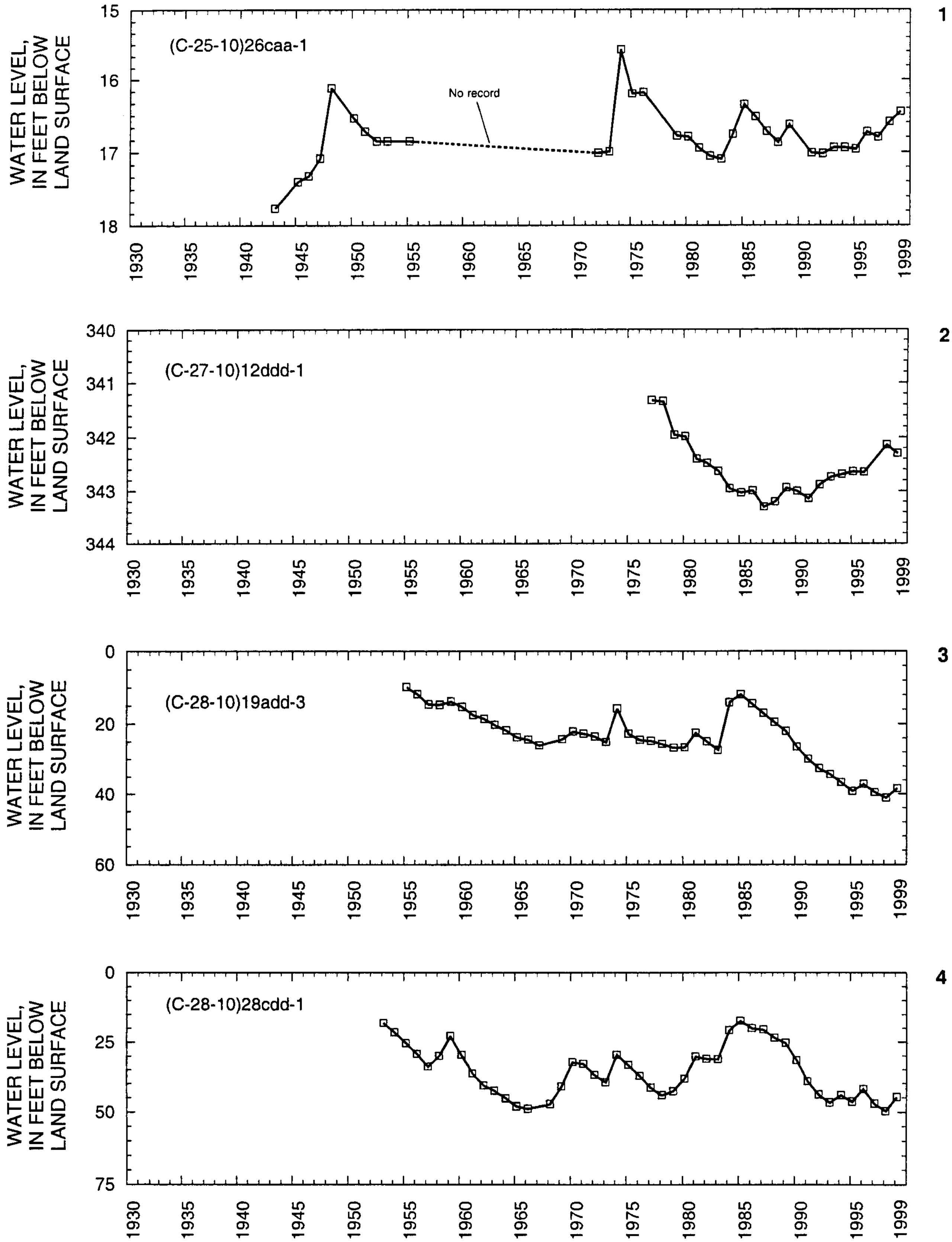


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1.

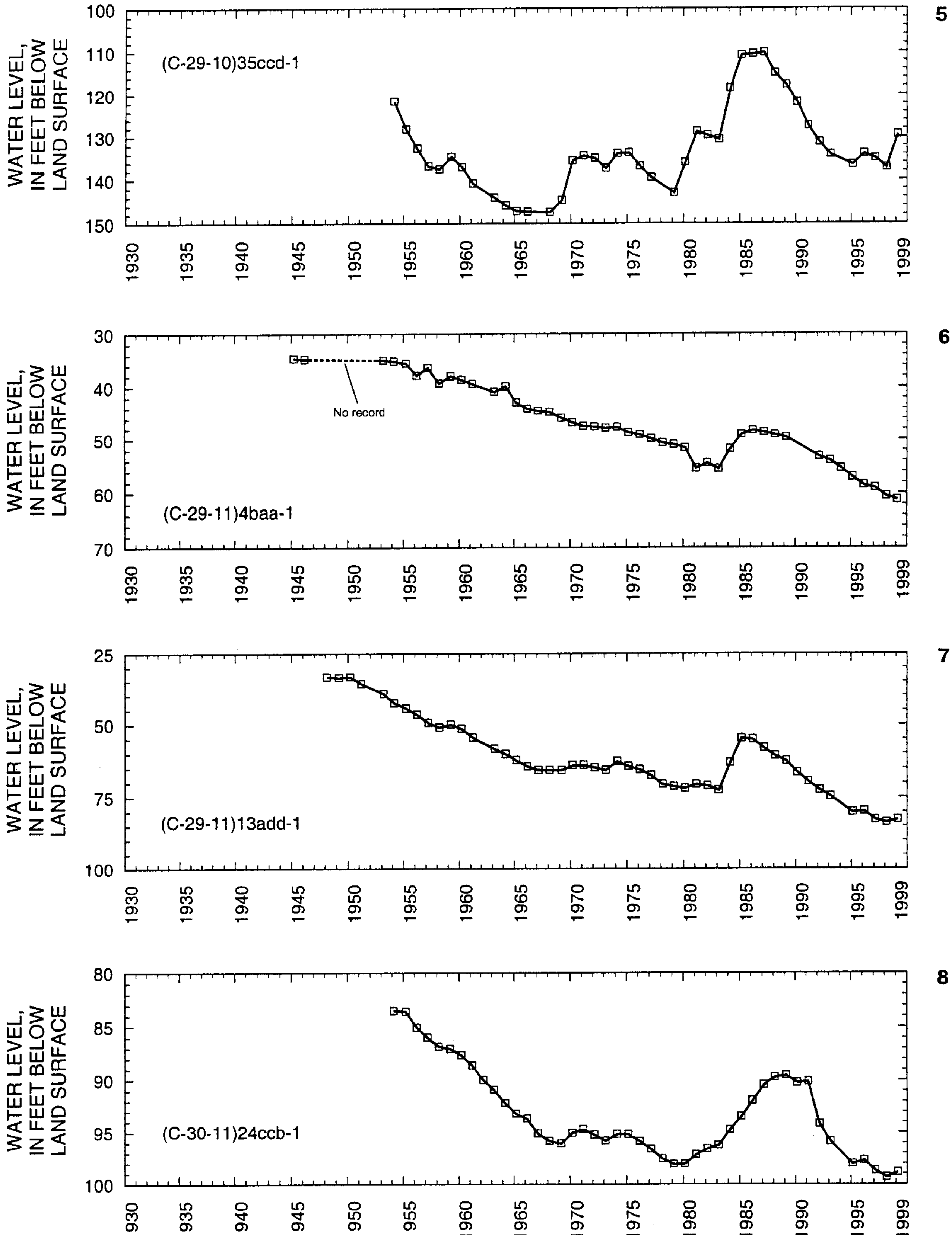
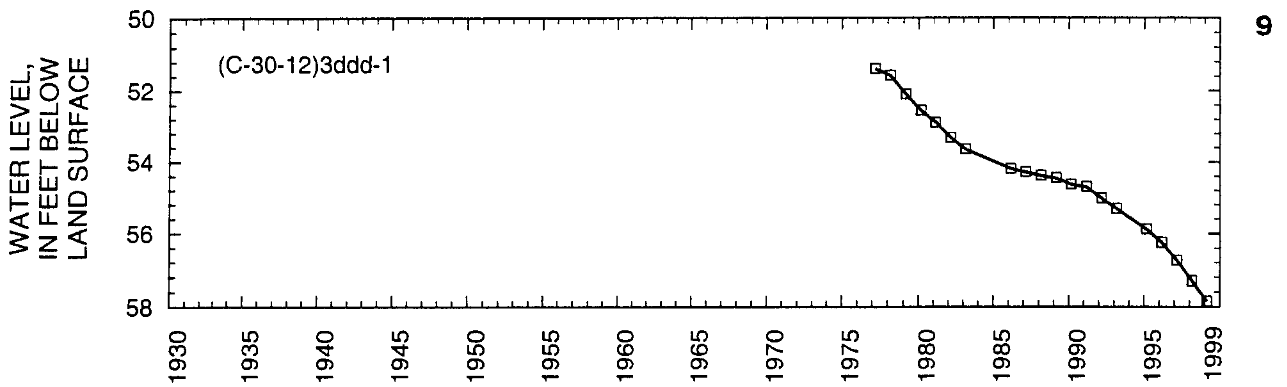


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1—Continued.



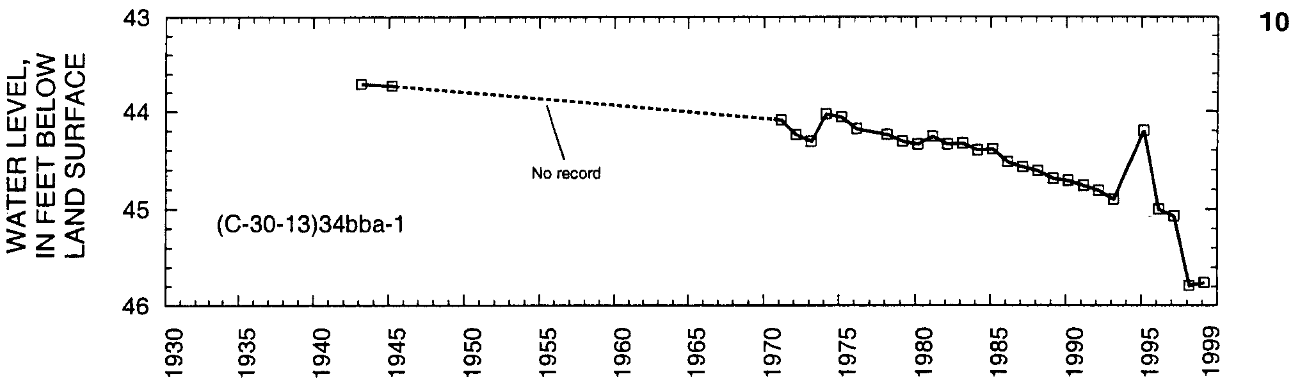


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1—Continued.

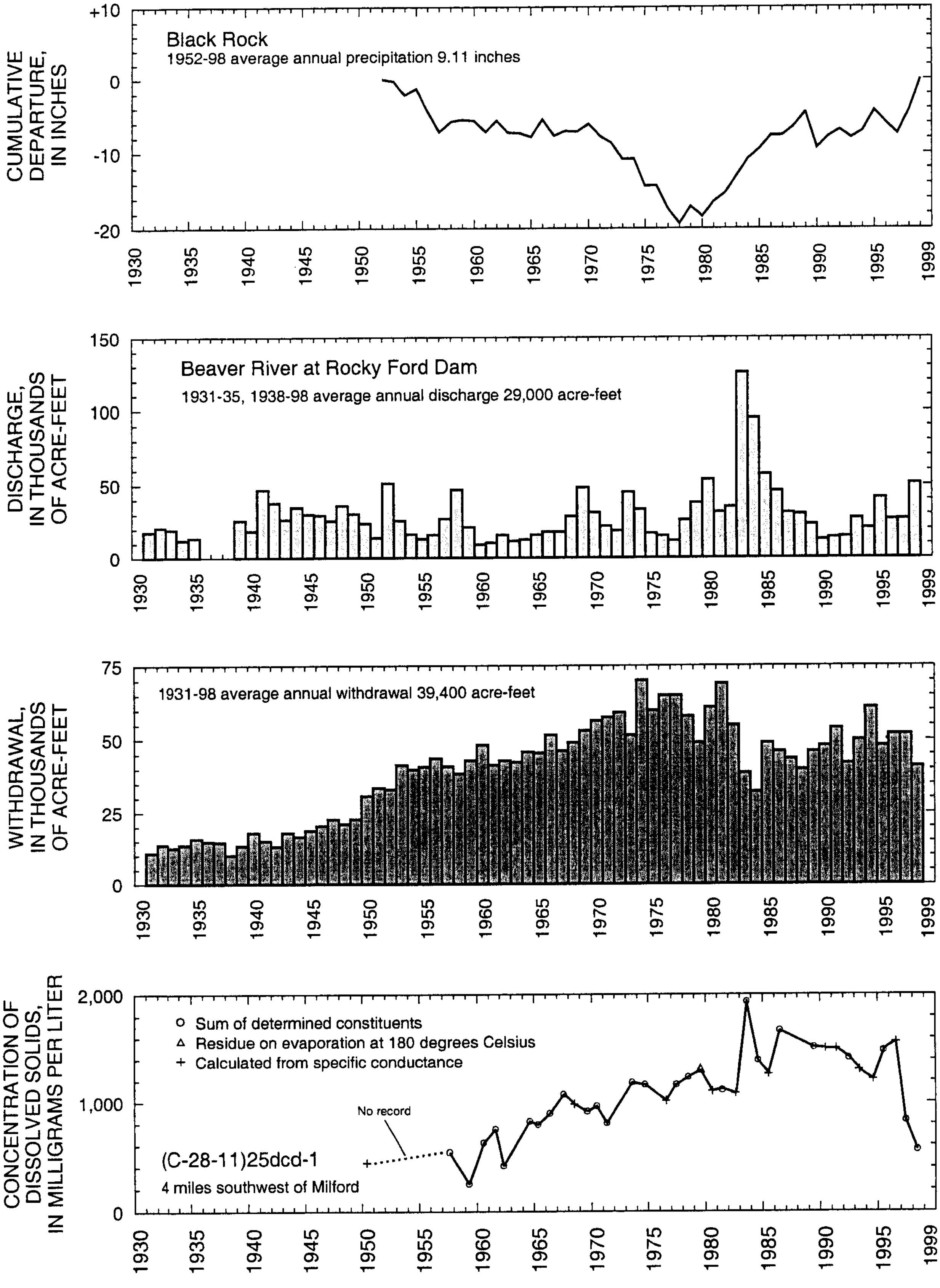


Figure 29. Relation of water level in selected wells in the Milford area to cumulative departure from average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1—Continued.

ESCALANTE VALLEY

Beryl-Enterprise Area

By H.K. Christiansen

The Beryl-Enterprise area covers about 400 square miles in the southern end of Escalante Valley. It is bounded by Mud Springs Hills, Bald Hills, and Three Peaks to the east, the Antelope Range and Shoal Creek to the south, and Wah Wah Mountains and Indian Peak Range to the north and west.

Total estimated withdrawal of water from wells in the Beryl-Enterprise area in 1998 was about 74,000 acre-feet, which is 7,000 acre-feet less than in 1997 and 8,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3).

The location of wells in which the water level was measured during March 1999 is shown in figure 30. The relation of the water level in selected wells to cumulative departure from average annual precipitation at Modena, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 31.

Long-term hydrographs for selected wells in the Beryl-Enterprise area show a general decline in water levels throughout the valley that resulted from the long-term increase in withdrawal for irrigation since the late 1940s. An exception is the water level in well (C-37-17)14dcd-2, south of Enterprise, which generally has risen since 1991. Water-level rises in this area probably resulted from greater-than-average precipitation in 5 of the previous 6 years and recharge from Pine Creek. The greatest water-level decline, about 93 feet since 1948, occurred in well (C-36-16)29daa-1, 5 miles northeast of Enterprise.

The 1998 precipitation at Modena was 15.14 inches, which is 4.68 inches more than the average annual precipitation for 1936-98 and 2.74 inches more than in 1997. Concentration of dissolved solids in water from well (C-34-16)28dcc-2 has increased from about 460 milligrams per liter in 1967 to about 600 milligrams per liter in 1998.

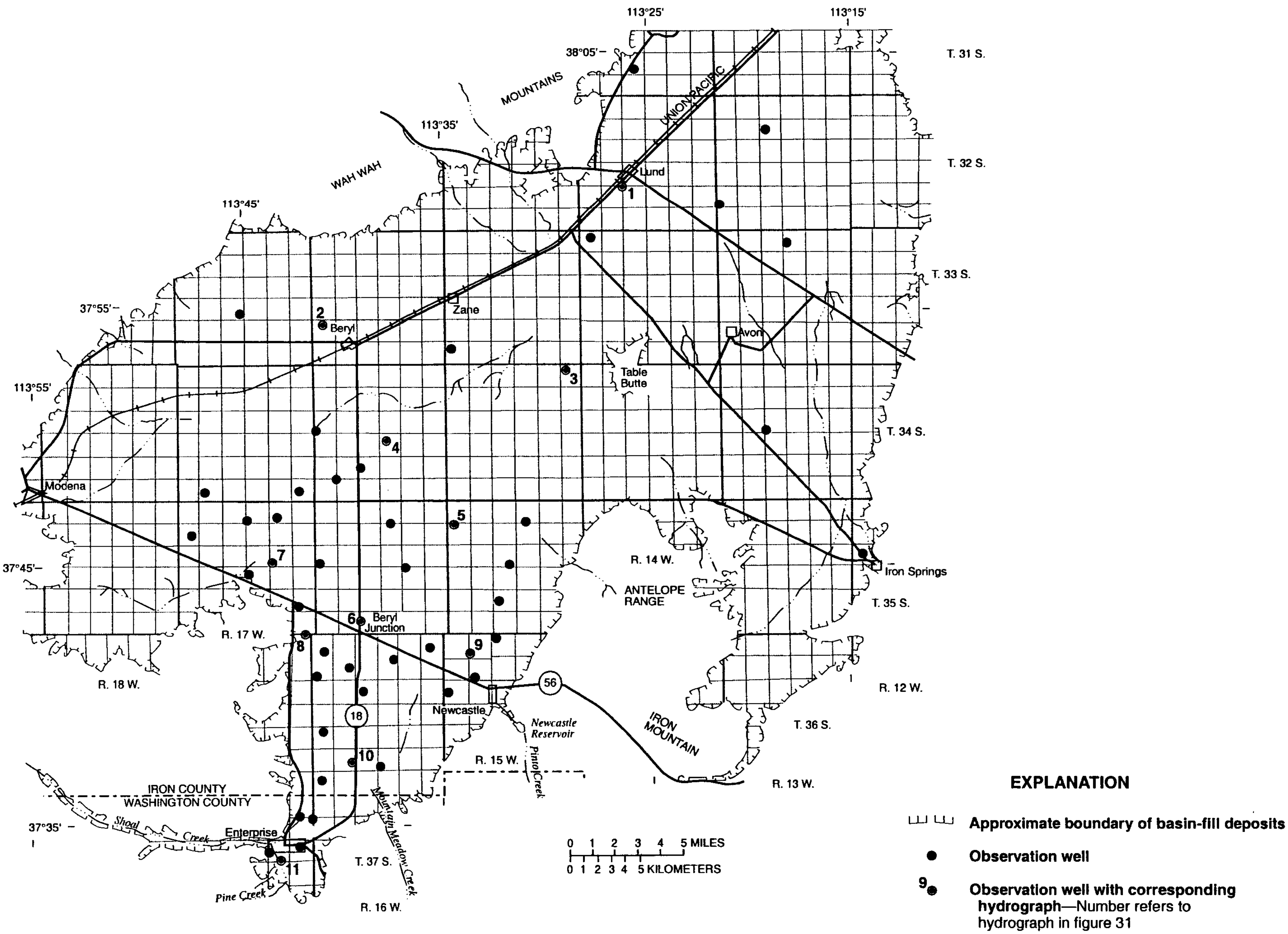


Figure 30. Location of wells in the Beryl-Enterprise area in which the water level was measured during March 1999.

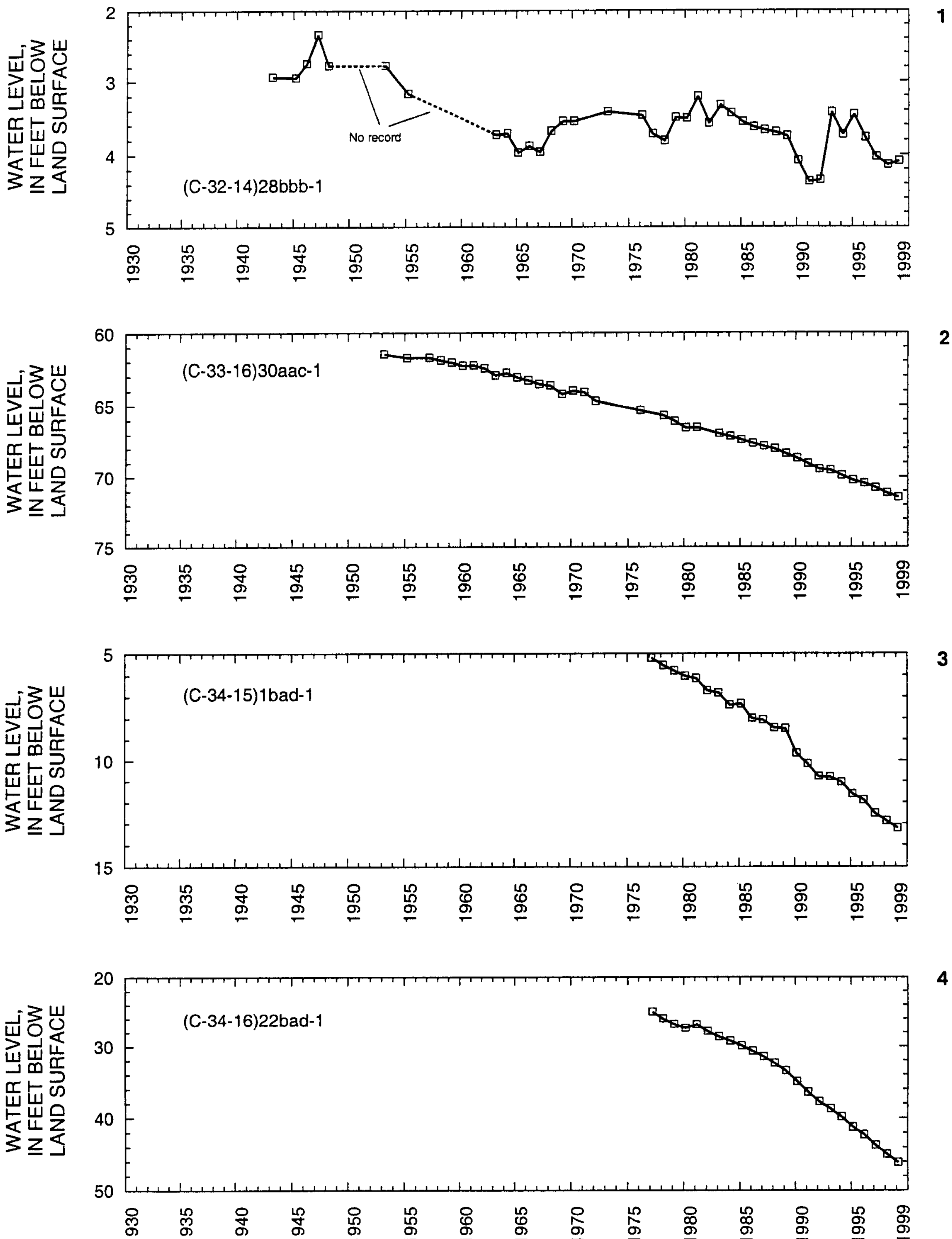


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Modena, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

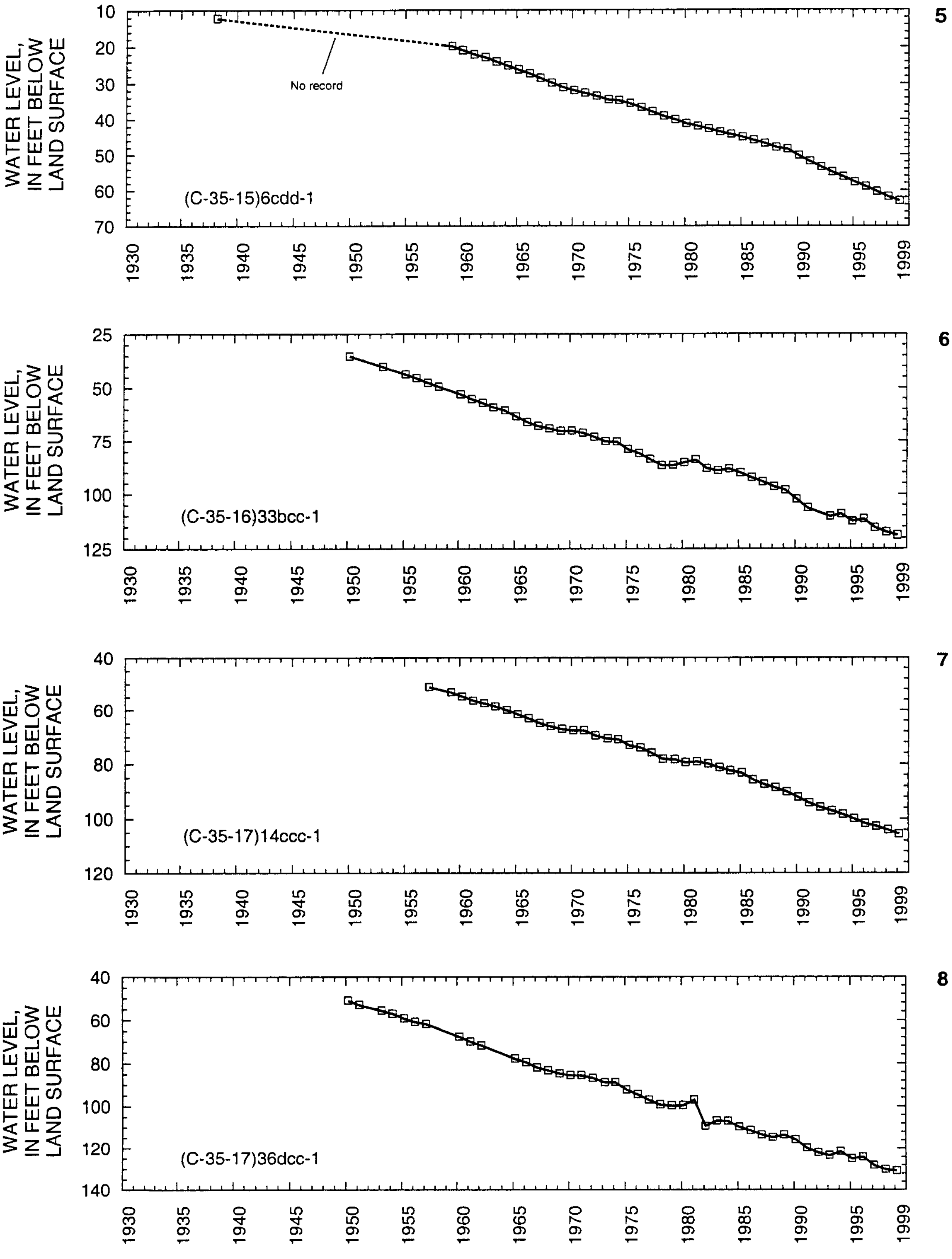


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Modena, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2—Continued.

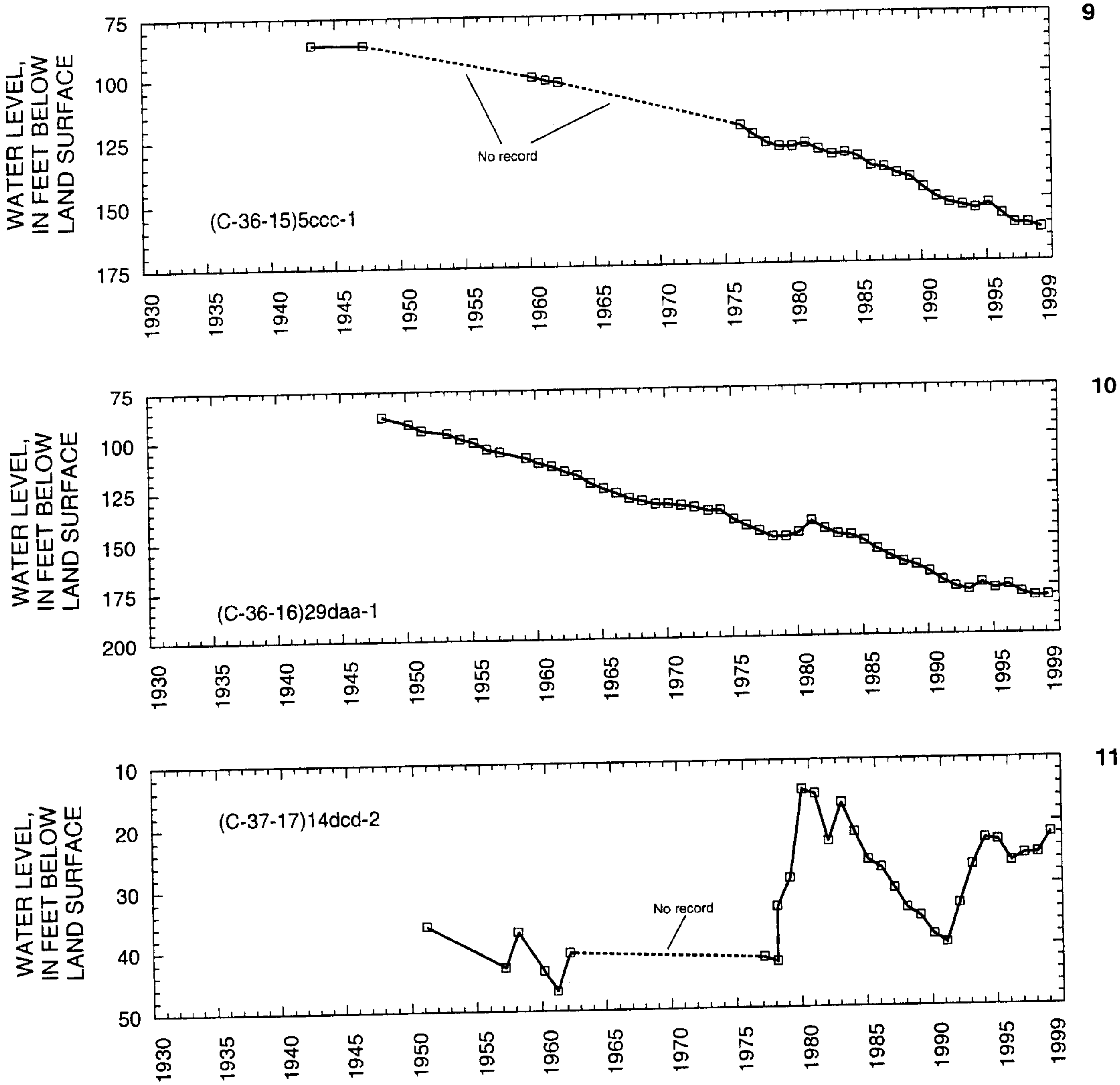


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Modena, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2—Continued.

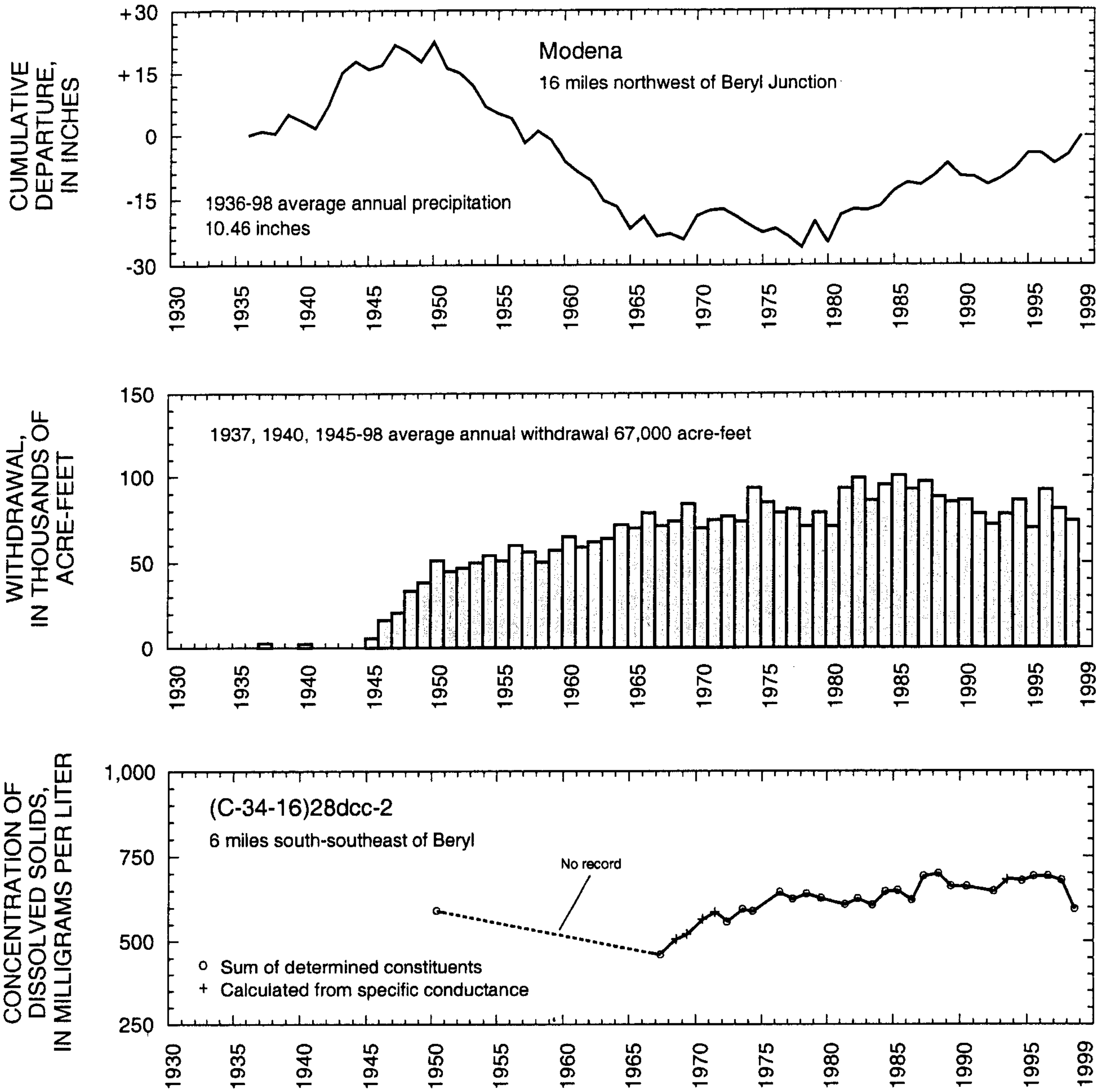


Figure 31. Relation of water level in selected wells in the Beryl-Enterprise area to cumulative departure from average annual precipitation at Modena, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2—Continued.

CENTRAL VIRGIN RIVER AREA

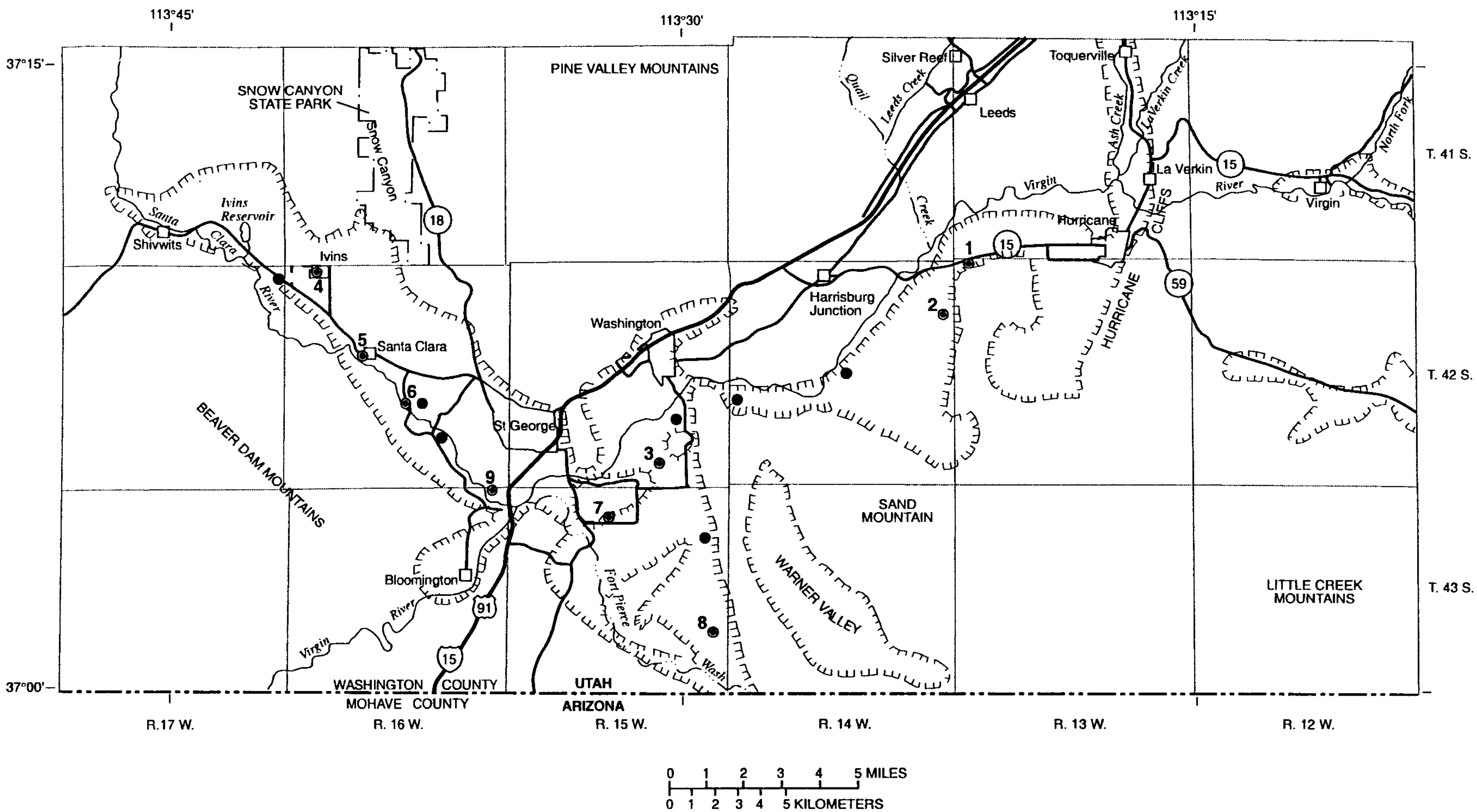
By H.K. Christiansen

The central Virgin River area is between the south end of the Pine Valley Mountains and the Hurricane Cliffs to the east and the White Hills to the southwest. Most of the wells measured are near the Virgin and Santa Clara Rivers.

Total estimated withdrawal of water from wells in the central Virgin River area in 1998 was about 20,000 acre-feet, which is 2,000 acre-feet more than was reported for 1997 and 3,000 acre-feet more than the average annual withdrawal for 1988-97 (tables 2 and 3). This withdrawal includes water from valley-fill aquifers used primarily for irrigation and water from consolidated rock and valley fill, which is used primarily for public supply. Withdrawal for irrigation in 1998 was about 800 acre-feet more than in 1997 and withdrawal for industry in 1998 was about the same as in 1997. Withdrawal for public supply was about 2,100 acre-feet more than the 1997 estimate.

The location of wells in which the water level was measured during February 1999 is shown in figure 32. The relation of the water level in selected wells to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1 is shown in figure 33. Long-term hydrographs for selected wells along the Santa Clara River and the Virgin River show that water levels measured in February have fluctuated with no general trend. The water-level fluctuations probably resulted from recharge from the Santa Clara and Virgin Rivers. The water level in well (C-43-15)25ddd-1, in the Fort Pierce Wash area, has declined the most, about 87 feet since 1961; and the water level in well (C-42-14)12dbb-1, 4 miles southeast of Harrisburg Junction, has declined more than 22 feet since 1991. These declines probably resulted from increased local withdrawal for irrigation.

Discharge of the Virgin River at Virgin in 1998 was about 193,400 acre-feet, which is 82,600 acre-feet more than the revised value of 110,800 acre-feet for 1997 and about 57,500 acre-feet more than the long-term average for 1931-70 and 1979-98. Precipitation at St. George in 1998 was 13.97 inches, which is 5.83 inches more than the average annual precipitation for 1947-98 and 3.26 inches more than in 1997. The concentration of dissolved solids in water from well (C-41-17)17cba-1 indicates little overall change since 1966.



EXPLANATION

Approximate boundary of valley-fill deposits

● Observation well

3 Observation well with corresponding hydrograph—Number refers to hydrograph in figure 33

Figure 32. Location of wells in the central Virgin River area in which the water level was measured during February 1999.

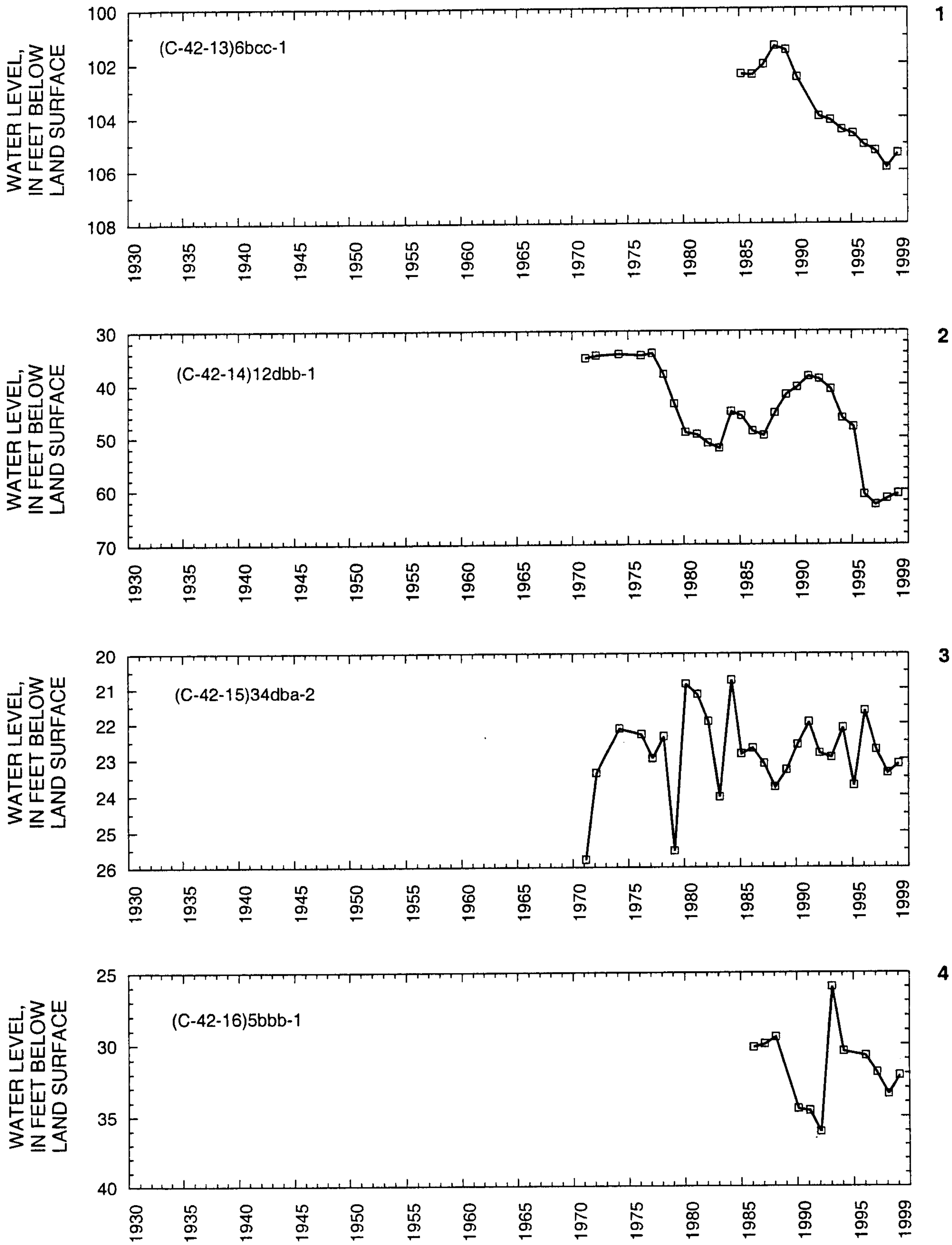
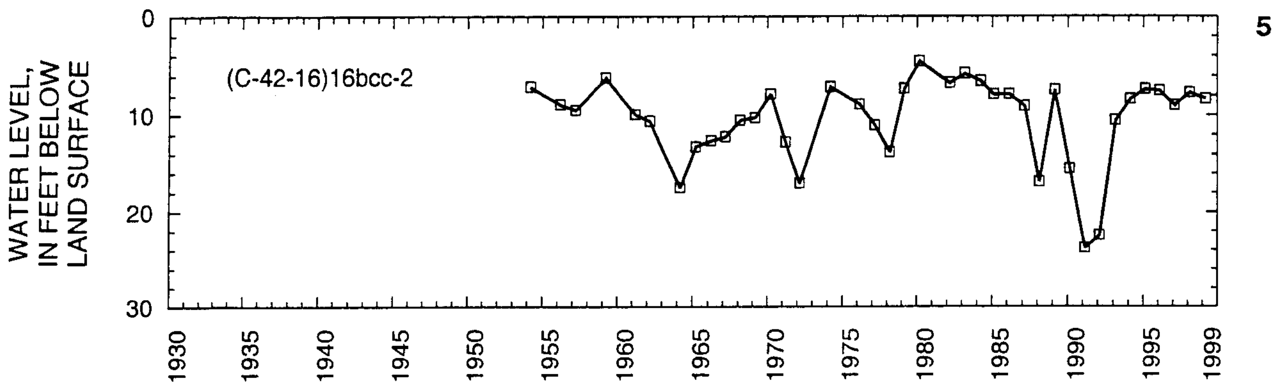
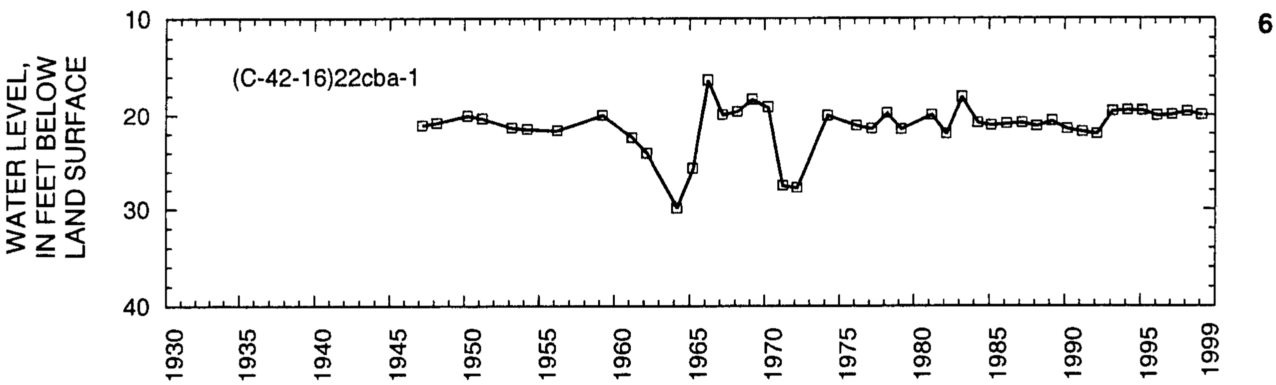


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1.





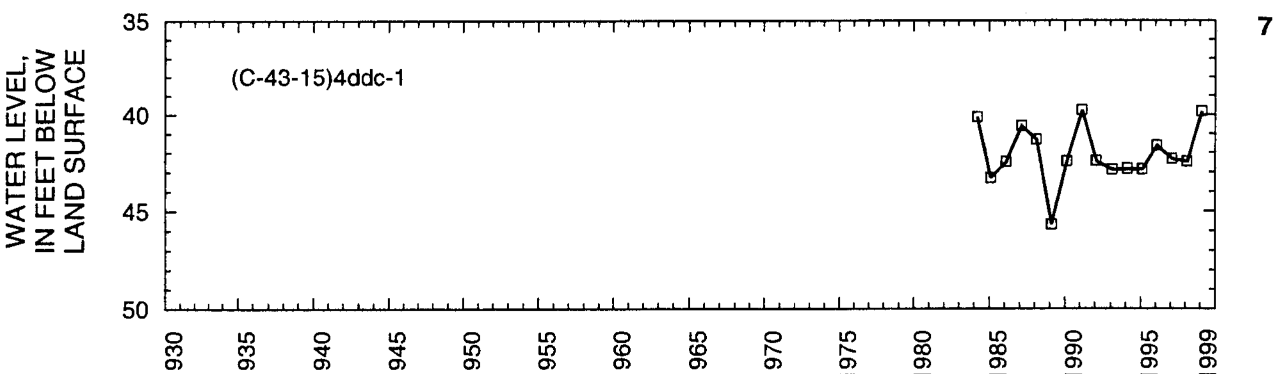
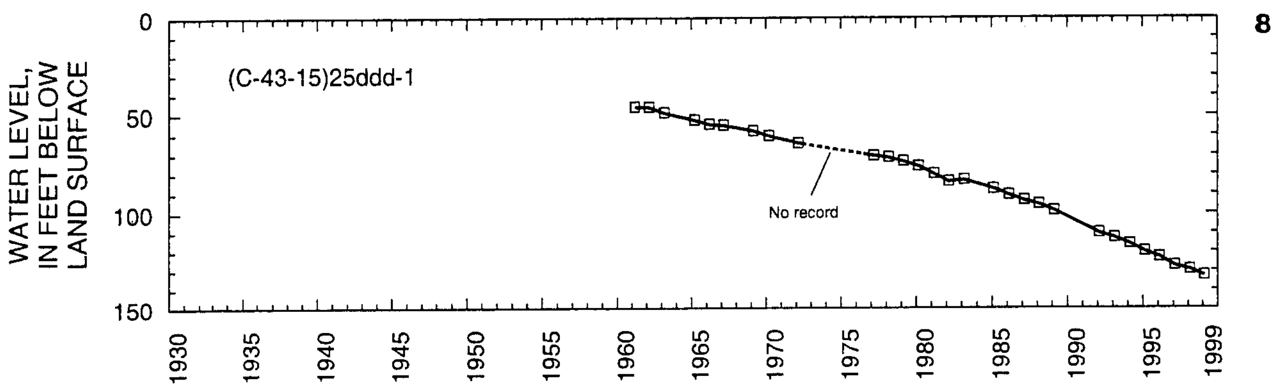


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1—Continued.



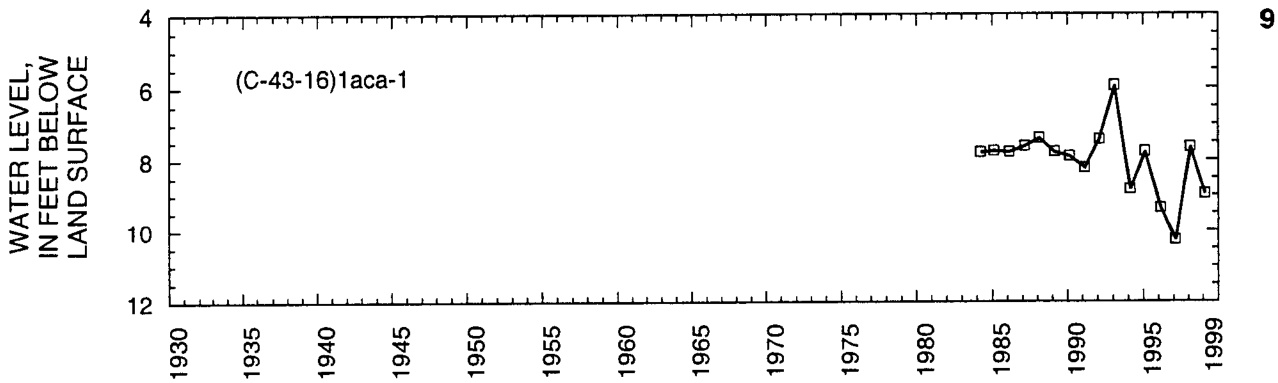


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1—Continued.

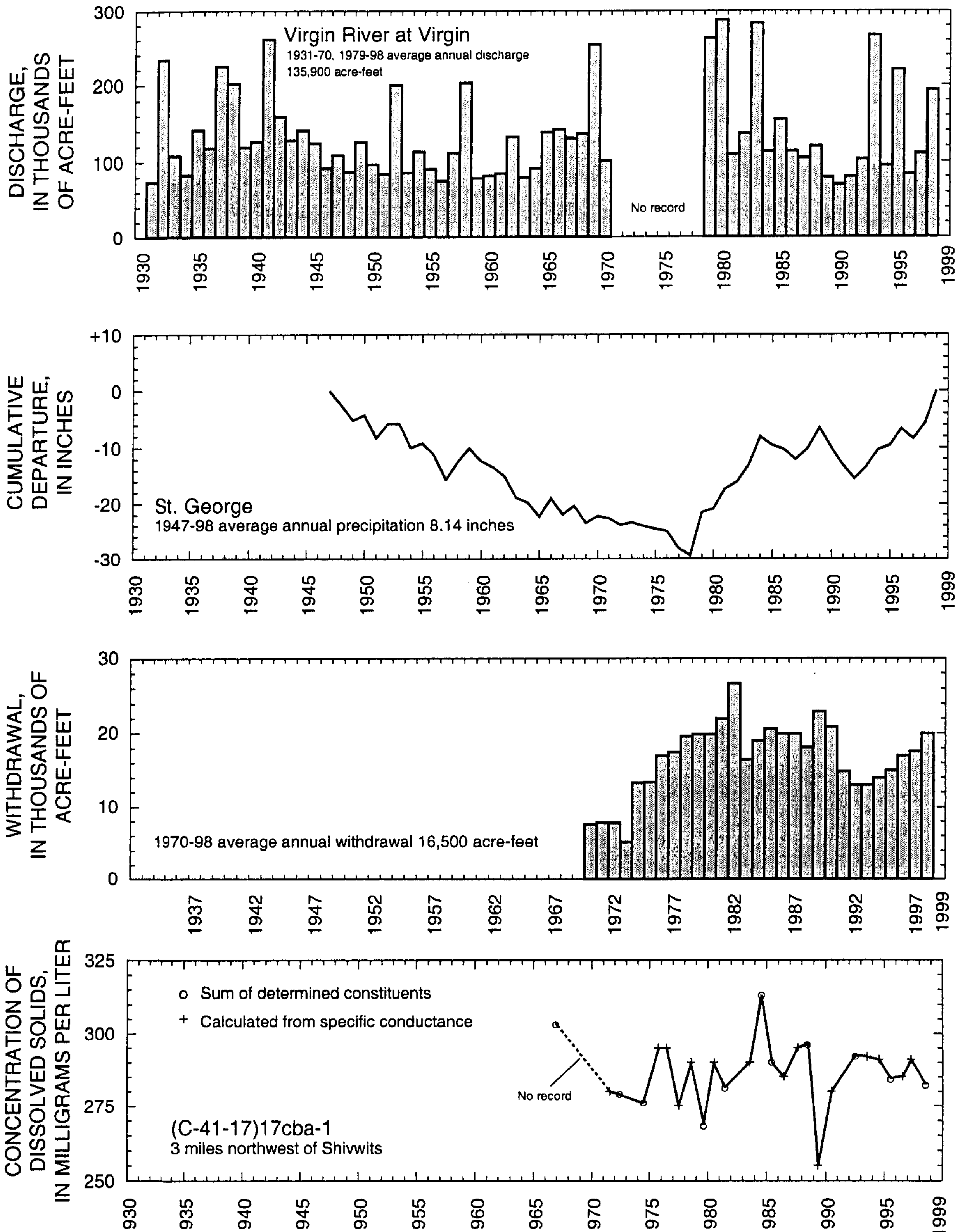


Figure 33. Relation of water level in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1—Continued.

OTHER AREAS

By M.J. Fisher

Total estimated withdrawal of water from wells in the areas of Utah listed below in 1998 was about 99,000 acre-feet, which was 8,000 acre-feet less than the estimate for 1997 and 7,000 acre-feet less than the average annual withdrawal for 1988-97 (tables 2 and 3). In the areas listed below, withdrawal in 1998 was less than in 1997 except in Park Valley, in Beaver Valley, and in the Dugway area, Skull Valley, and Old River Bed. The decrease in withdrawal resulted from decreased irrigation and industrial use.

The location of wells in Cedar Valley, Utah County, in which the water level was measured during March 1999 is shown in figure 34. The relation of the water level in wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Fairfield is shown in figure 35. March water levels in the selected wells generally rose during the 1970s. Water levels rose sharply from the early to mid-1980s as a result of greater-than-average precipitation but generally have declined since the mid-1980s because of continued withdrawal and less precipitation. March water levels rose in most of the selected wells from 1998-99. The rises probably resulted from decreased irrigation withdrawals and greater-than-average precipitation.

The location of wells in Sanpete Valley in which the water level was measured during March 1999 is shown in figure 36. The relation of the water level in wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti is shown in figure 37. March water levels in many of the selected wells rose from the late 1970s to the mid-1980s as a result of greater-than-average precipitation and have declined since the mid-1980s. March water levels rose in most of the selected wells during 1998-99. The rises probably resulted from decreased withdrawal for irrigation during 1998 and greater-than-average precipitation.

The relation of the water level in selected wells in the remaining areas of Utah (see accompanying table) to cumulative departure from average annual precipitation at sites in or near those areas is shown in figure 38. March water levels generally rose in most of the selected observation wells from 1998 to 1999. The rises probably resulted from decreased withdrawals for public supply and local irrigation. Water-level rises in some of the areas from 1998 to 1999 probably resulted from greater-than-average precipitation and (or) increased local recharge from surface water.

March water-level trends generally showed a decline during 1995-99 in most of the "Other Areas" selected wells. Declines probably resulted from greater-than-average withdrawals during this period. The rising water-level trends for this period in some wells probably resulted from increased precipitation.

Number in figure 1	Area	Estimated withdrawal (acre-feet) 1998 Irrigation	Industrial	Public supply	Domestic and stock	1998 total	1997 total
1	Grouse Creek Valley	3,300	0	0	20	3,300	3,800
2	Park Valley	2,500	0	0	10	2,500	2,200
4	Malad-lower Bear River Valley	3,700	1,050	1,300	200	6,200	8,300
8	Ogden Valley	0	0	12,400	20	12,400	12,600
13	Rush Valley	3,900	200	330	30	4,500	5,600
14	Dugway area, Skull Valley, and Old River Bed	1,000	3,730	3,800	10	8,500	7,500
15	Cedar Valley, Utah County	4,200	0	100	40	4,300	5,300
20	Sanpete Valley	3,300	520	470	4,000	8,300	9,800
25	Snake Valley	6,700	0	30	50	6,800	8,600
27	Beaver Valley	7,600	10	360	400	8,400	8,200
	Remainder of State	14,300	6,080	10,900	2,500	33,800	34,900
Total (rounded)		50,500	11,600	29,700	7,300	99,000	107,000

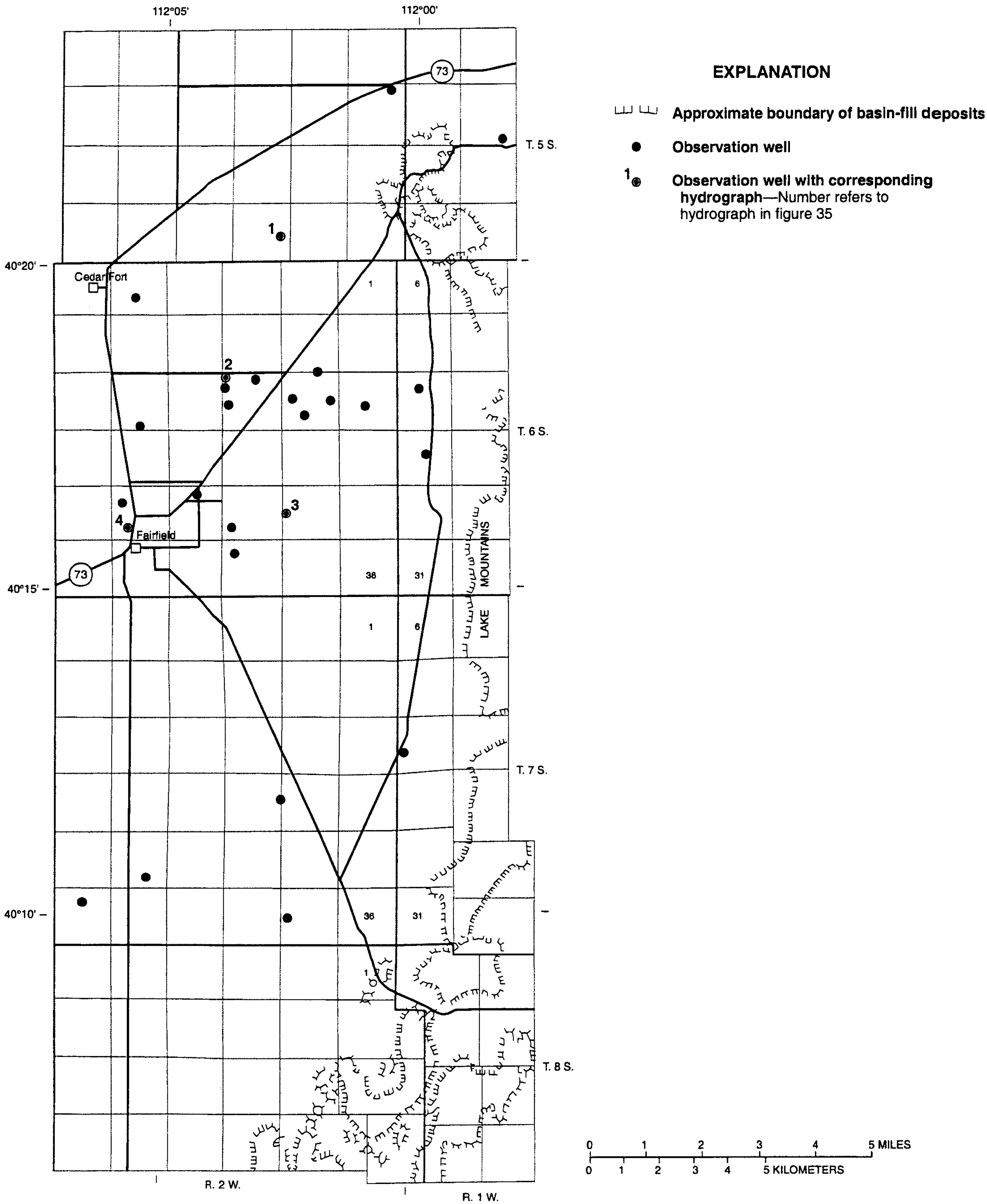


Figure 34. Location of wells in Cedar Valley, Utah County, in which the water level was measured during March 1999.

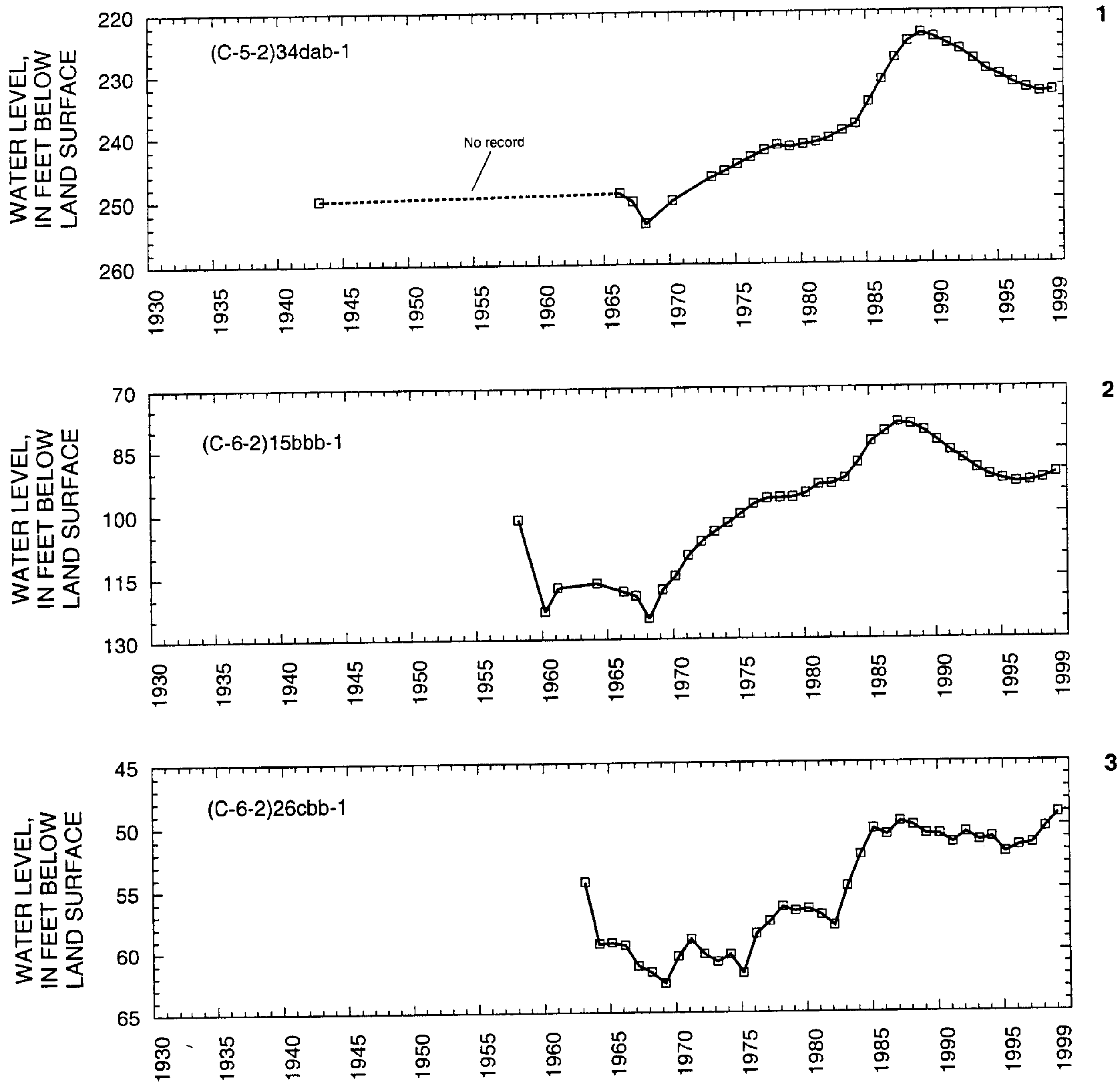


Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Fairfield.

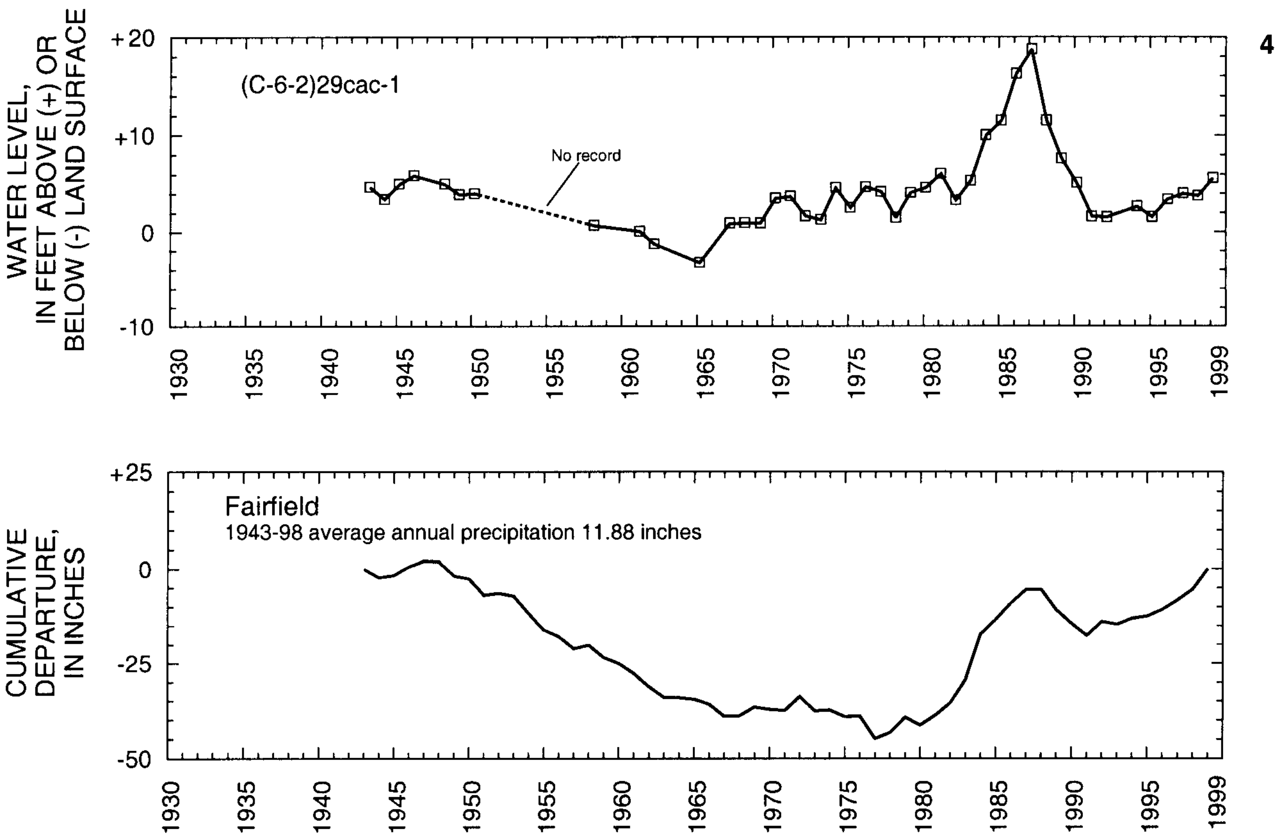


Figure 35. Relation of water level in selected wells in Cedar Valley, Utah County, to cumulative departure from average annual precipitation at Fairfield—Continued.

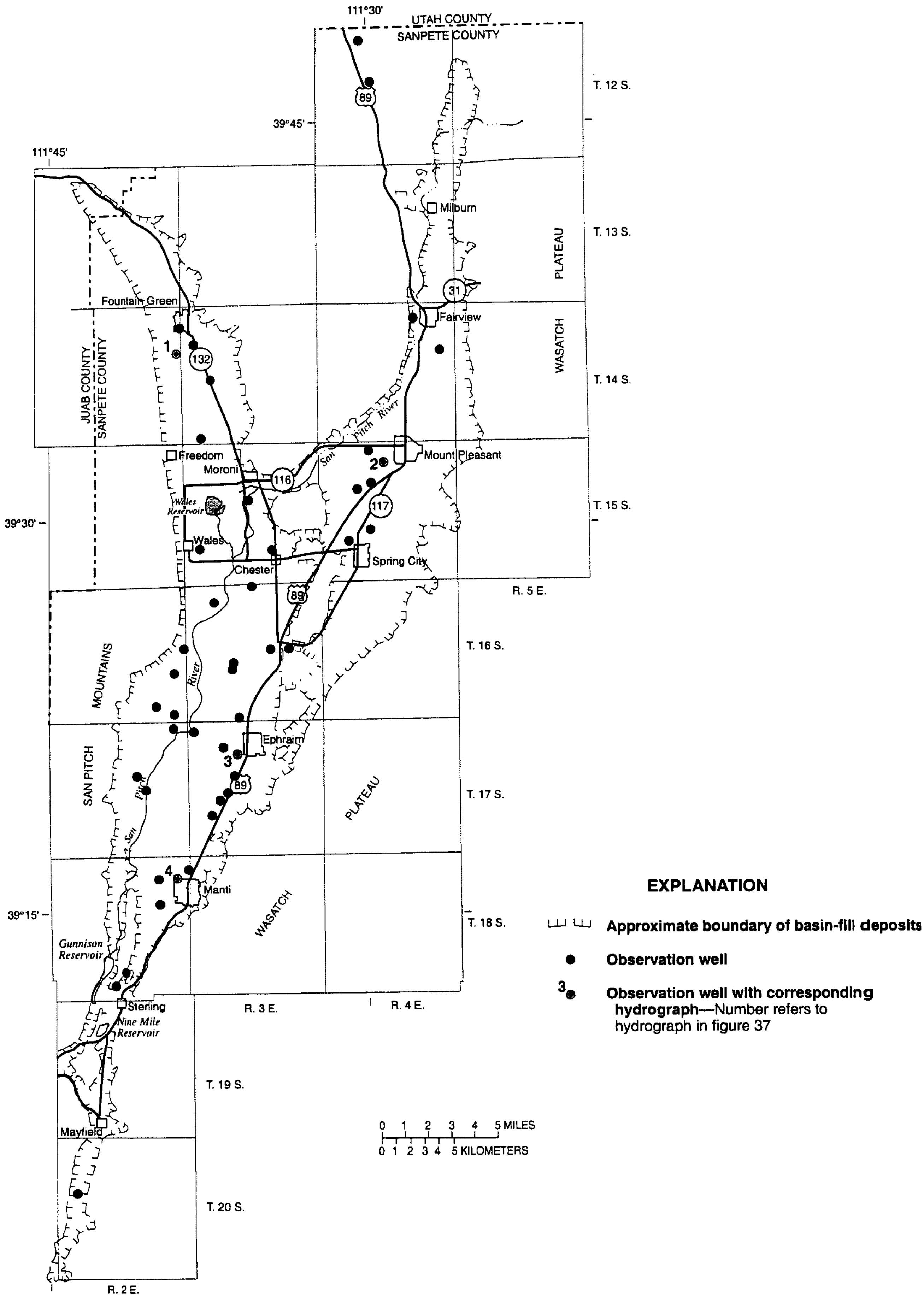


Figure 36. Location of wells in Sanpete Valley in which the water level was measured during March 1999.

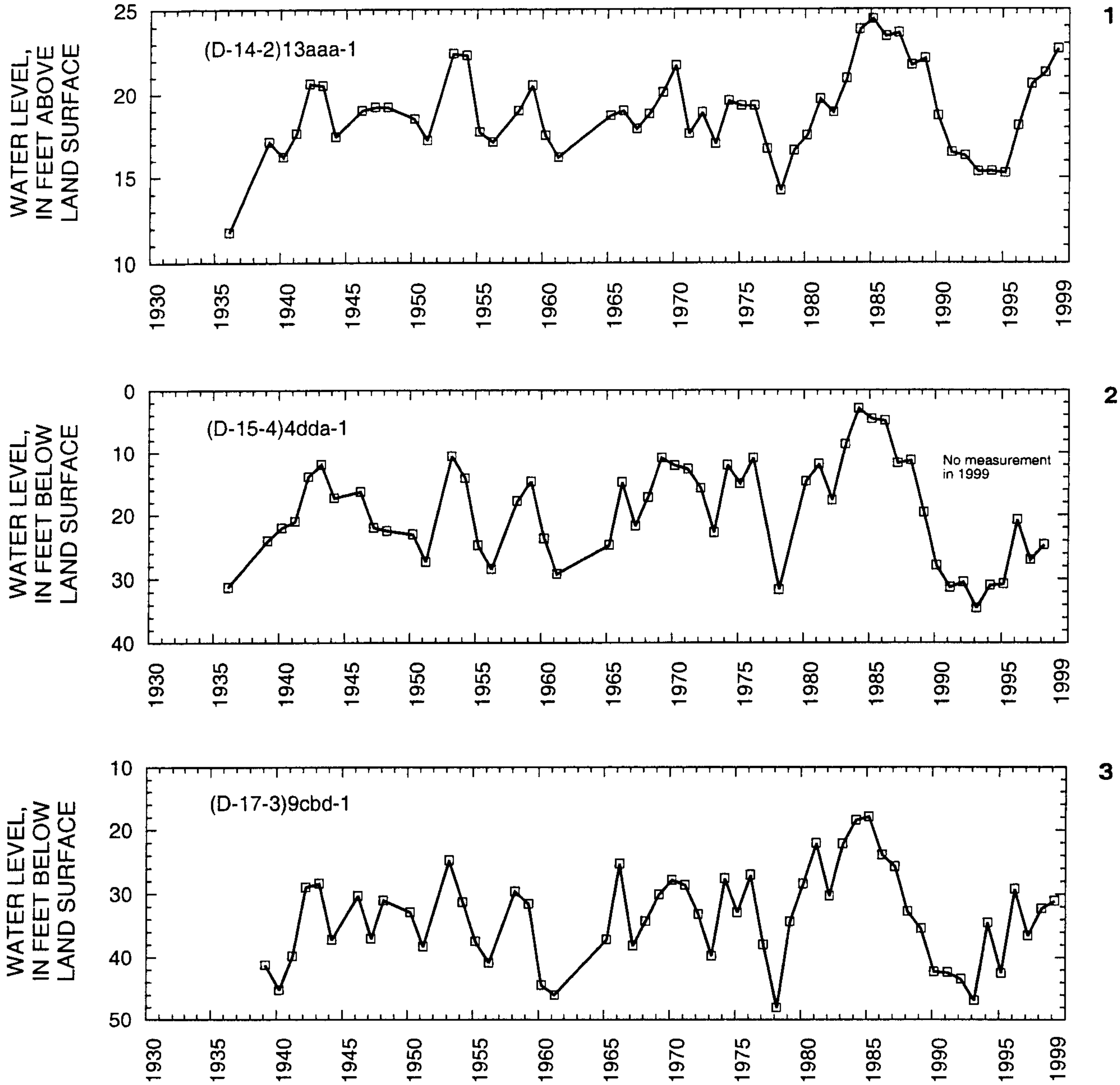


Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti.

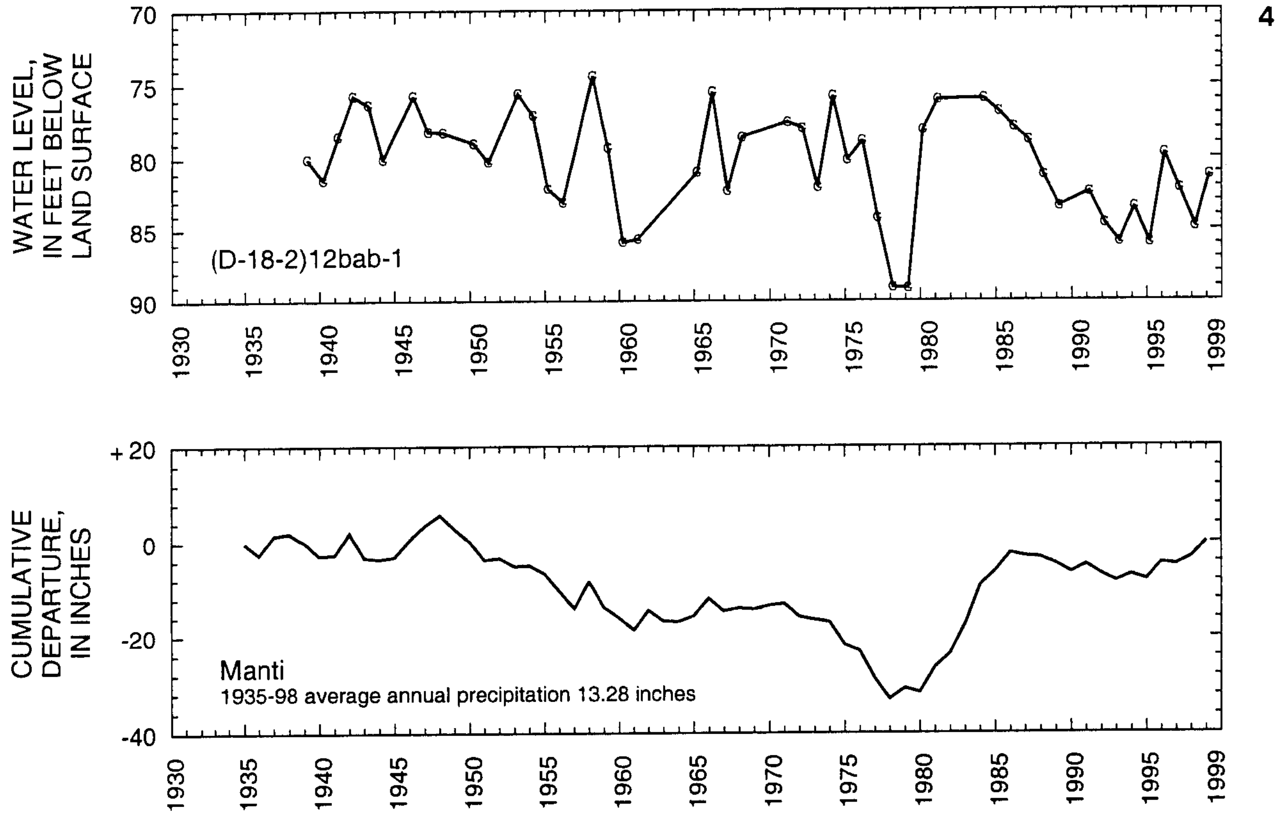


Figure 37. Relation of water level in selected wells in Sanpete Valley to cumulative departure from average annual precipitation at Manti–Continued.

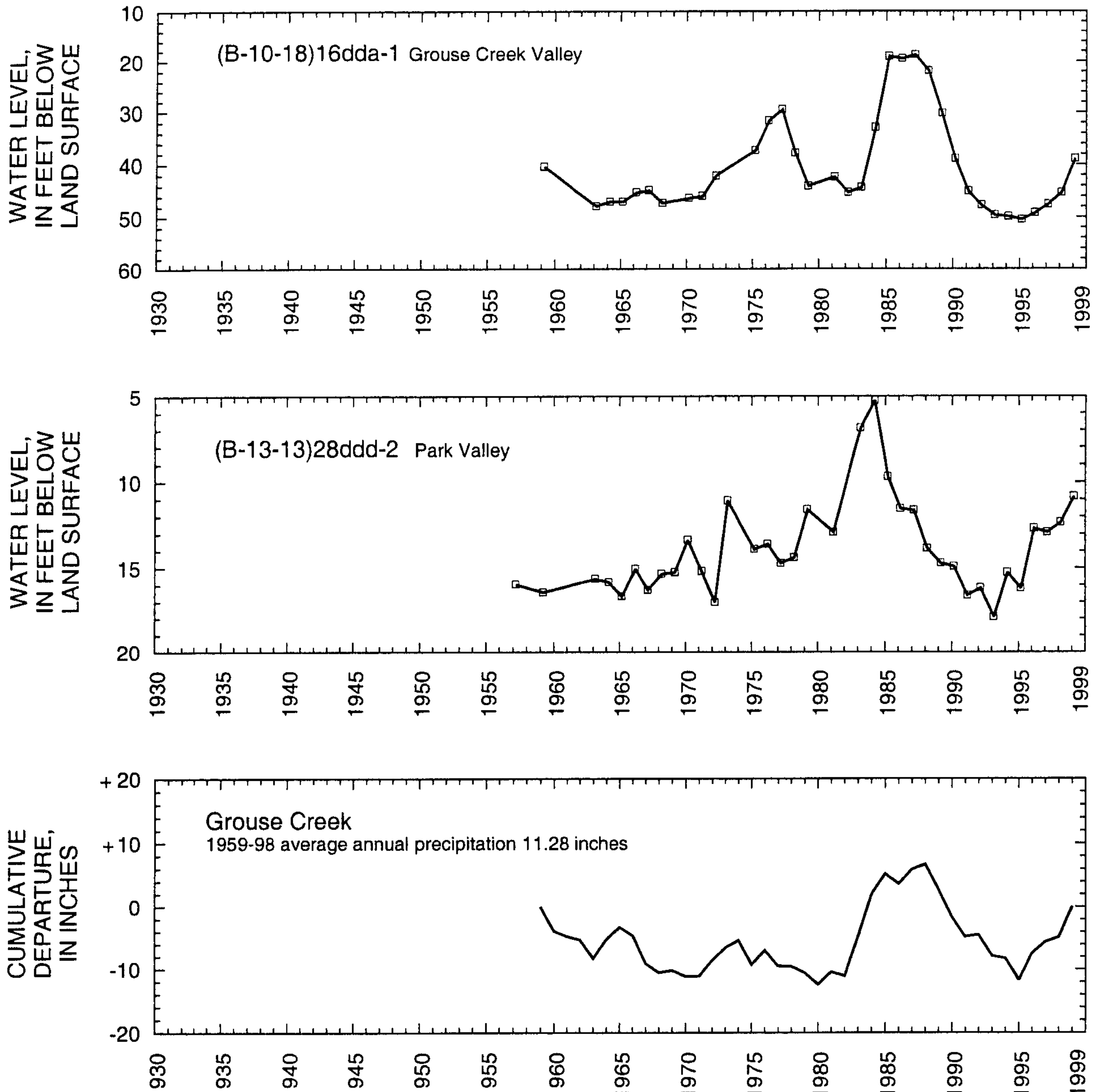


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas.

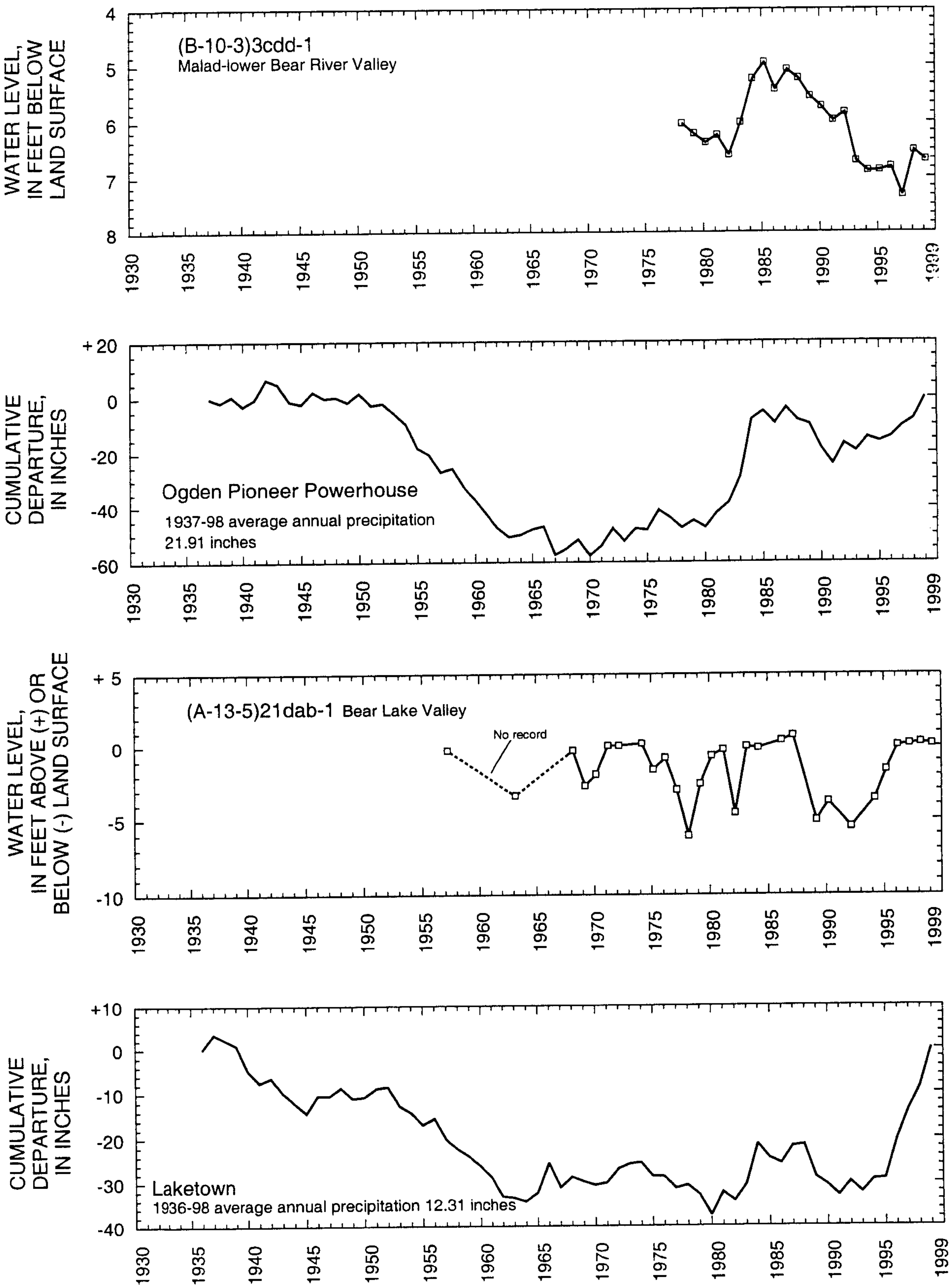


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

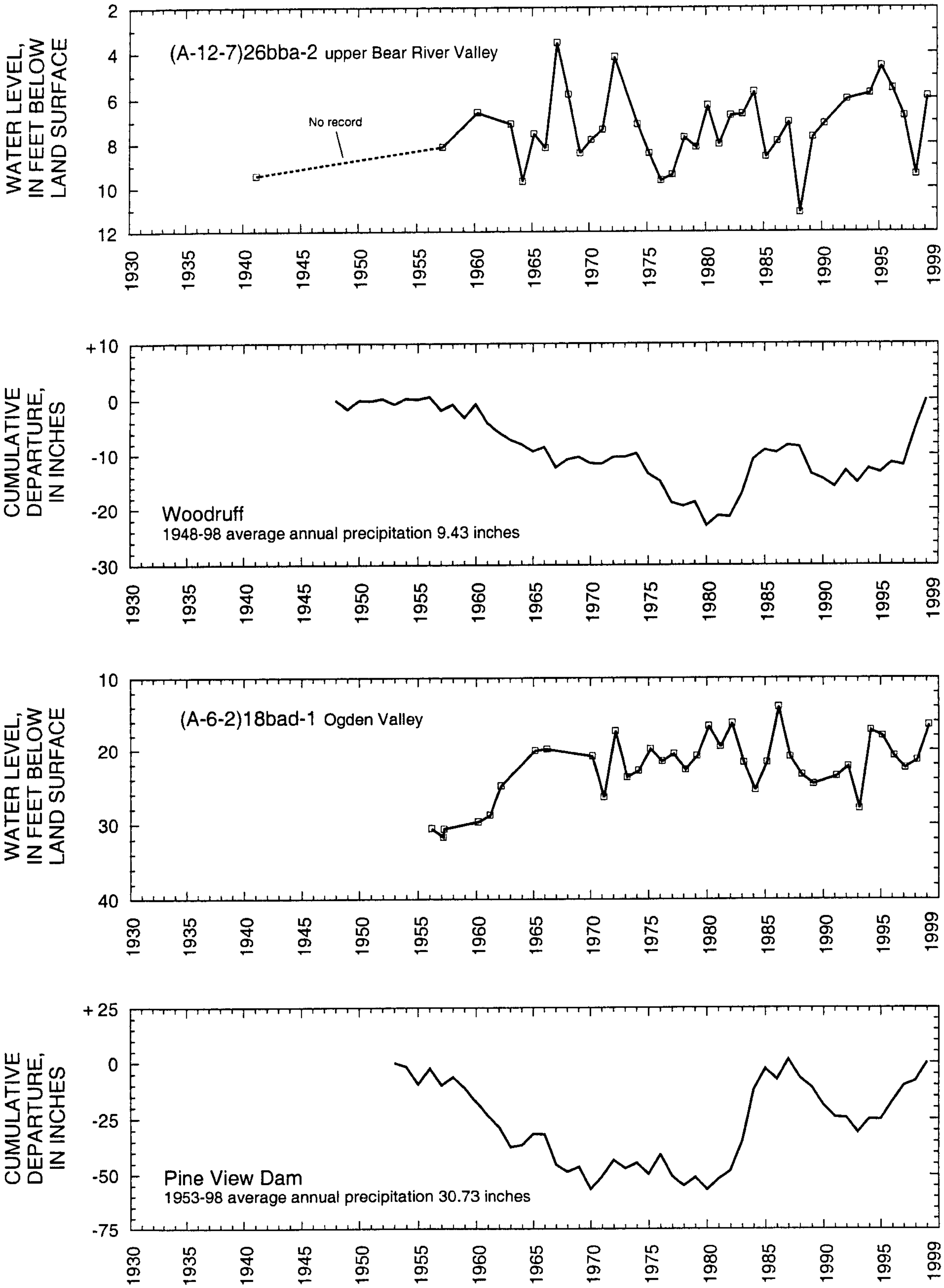


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

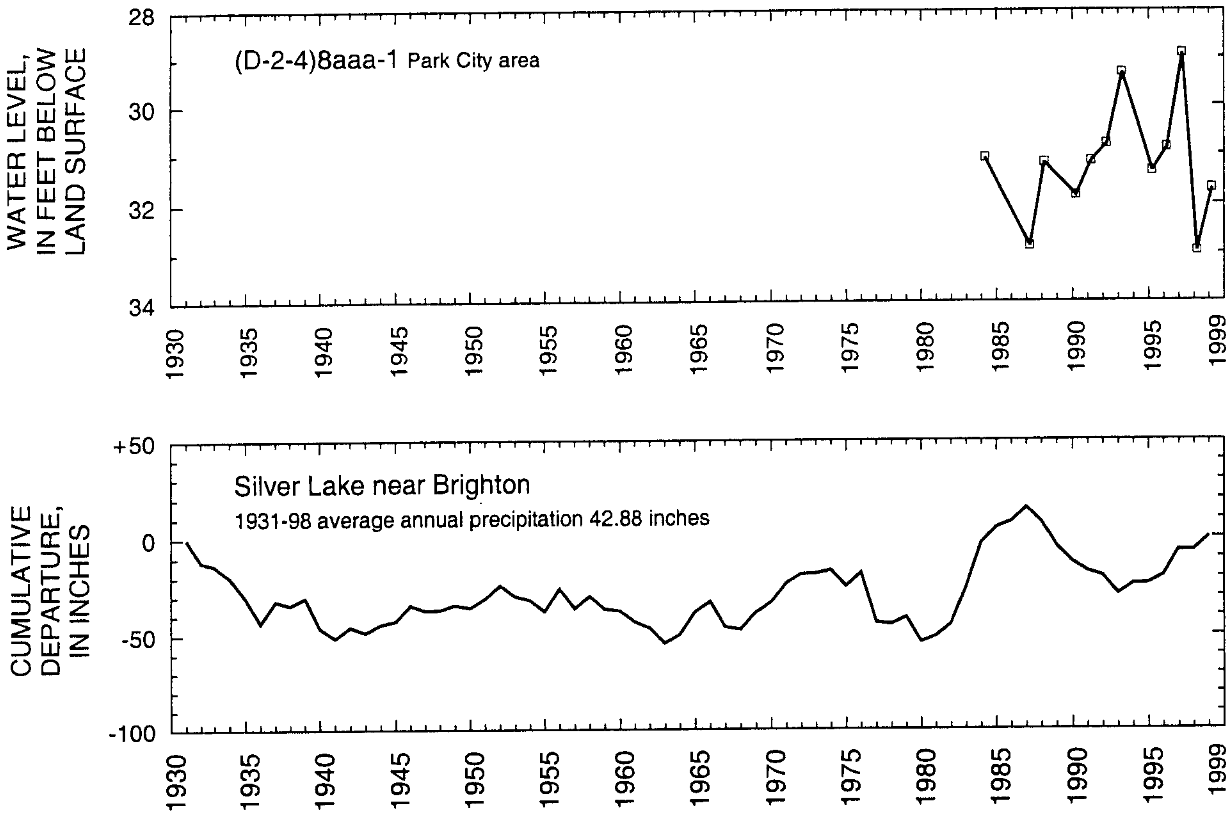


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

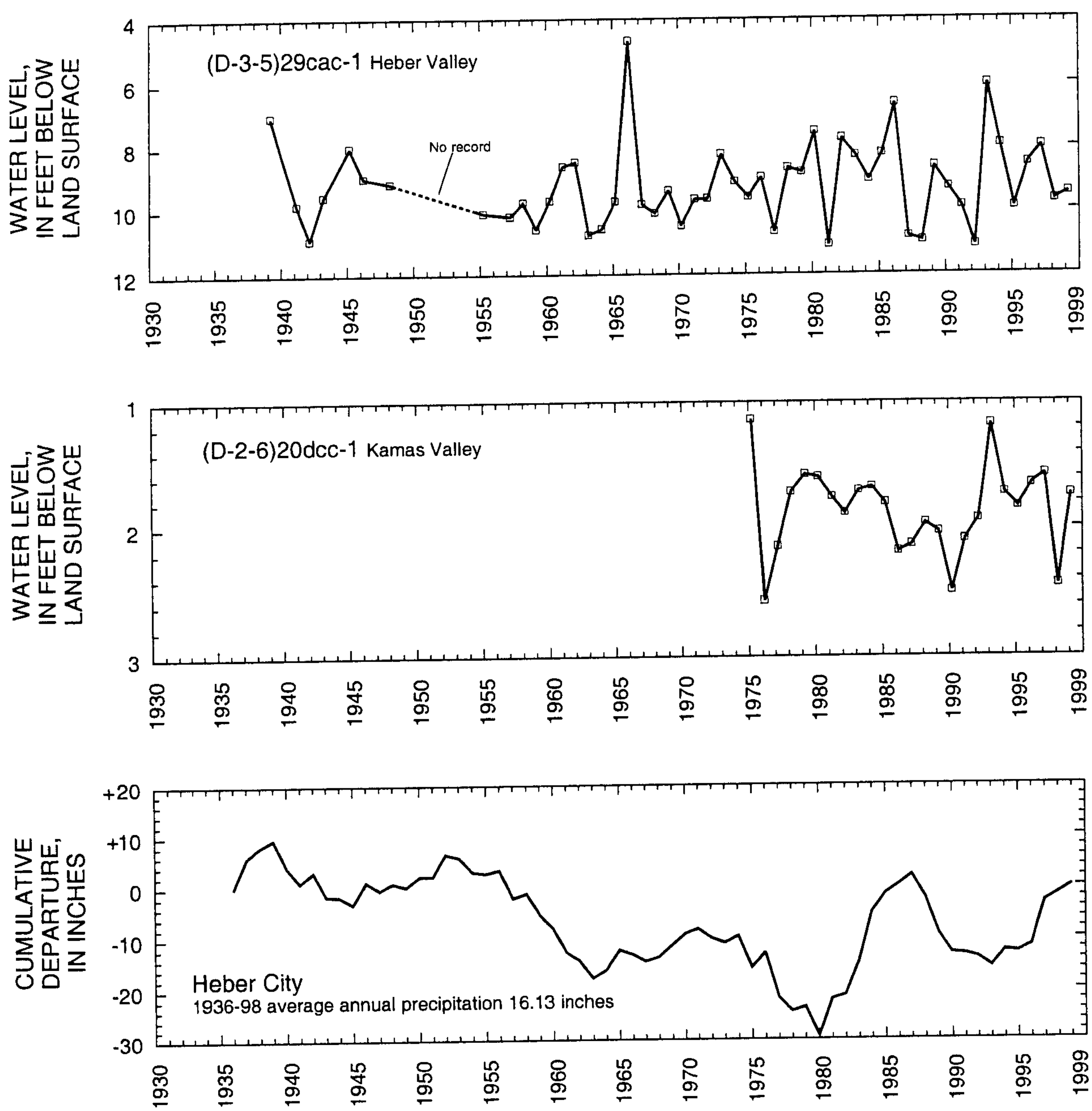


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

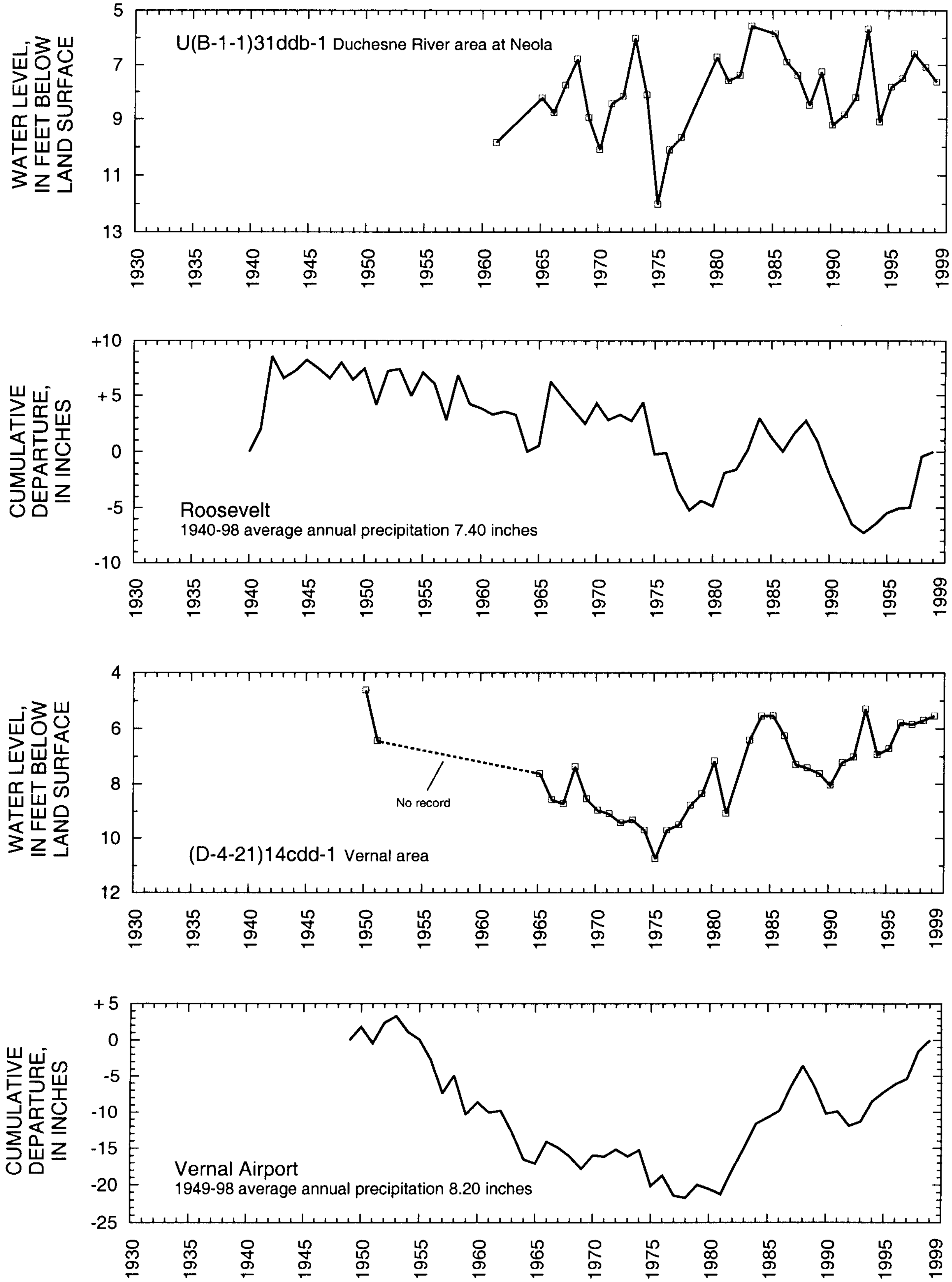


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

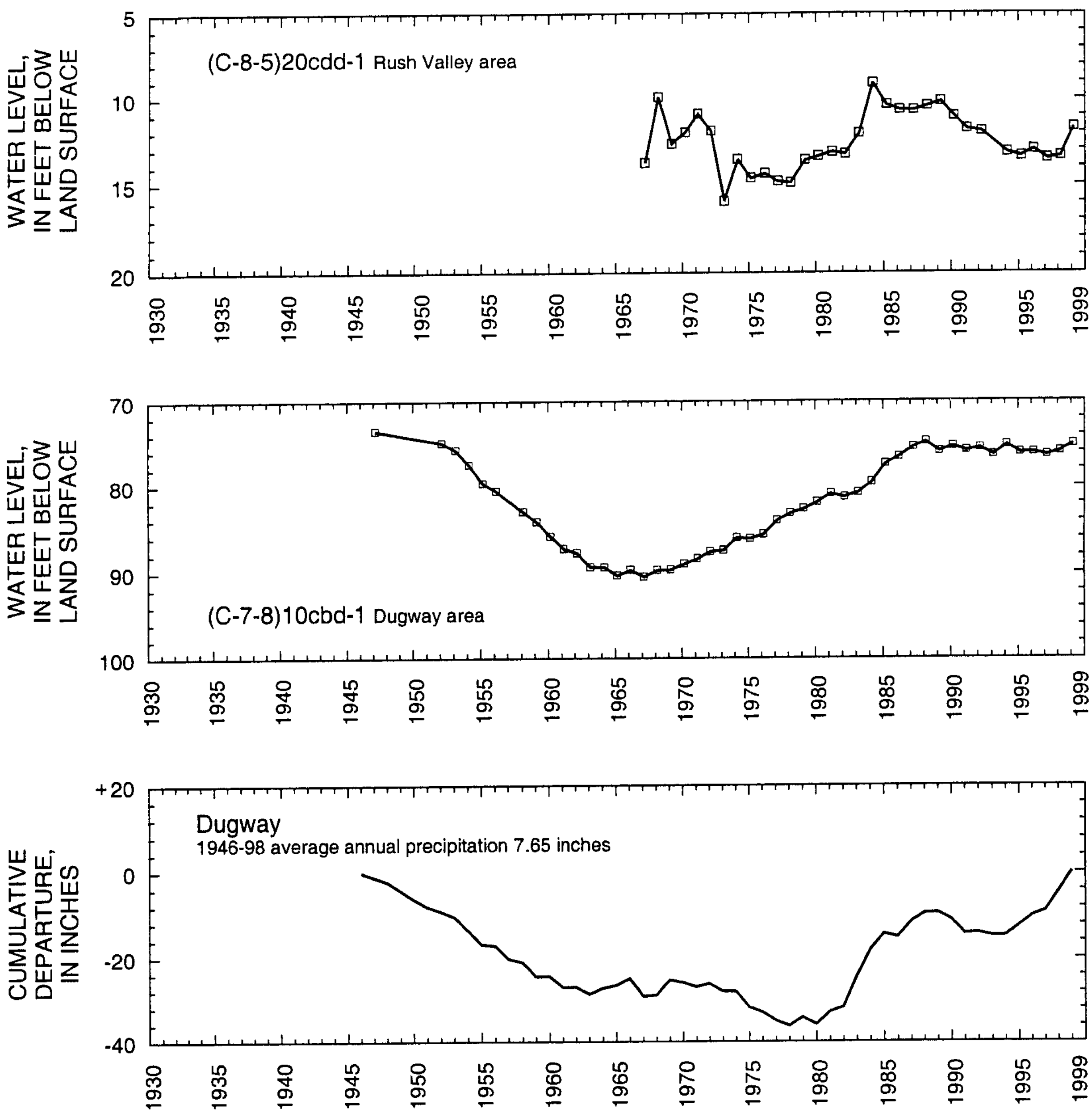


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

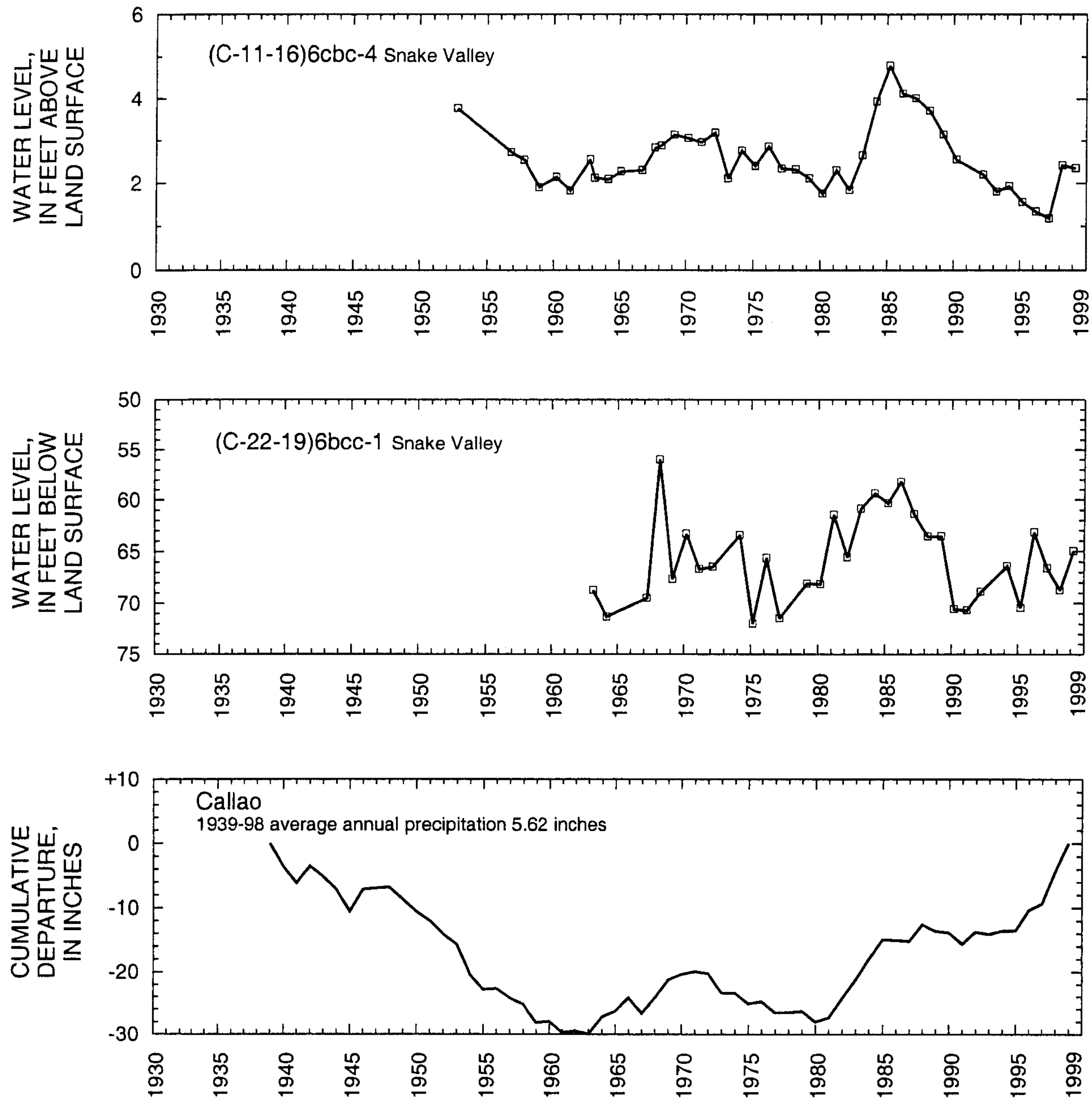


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

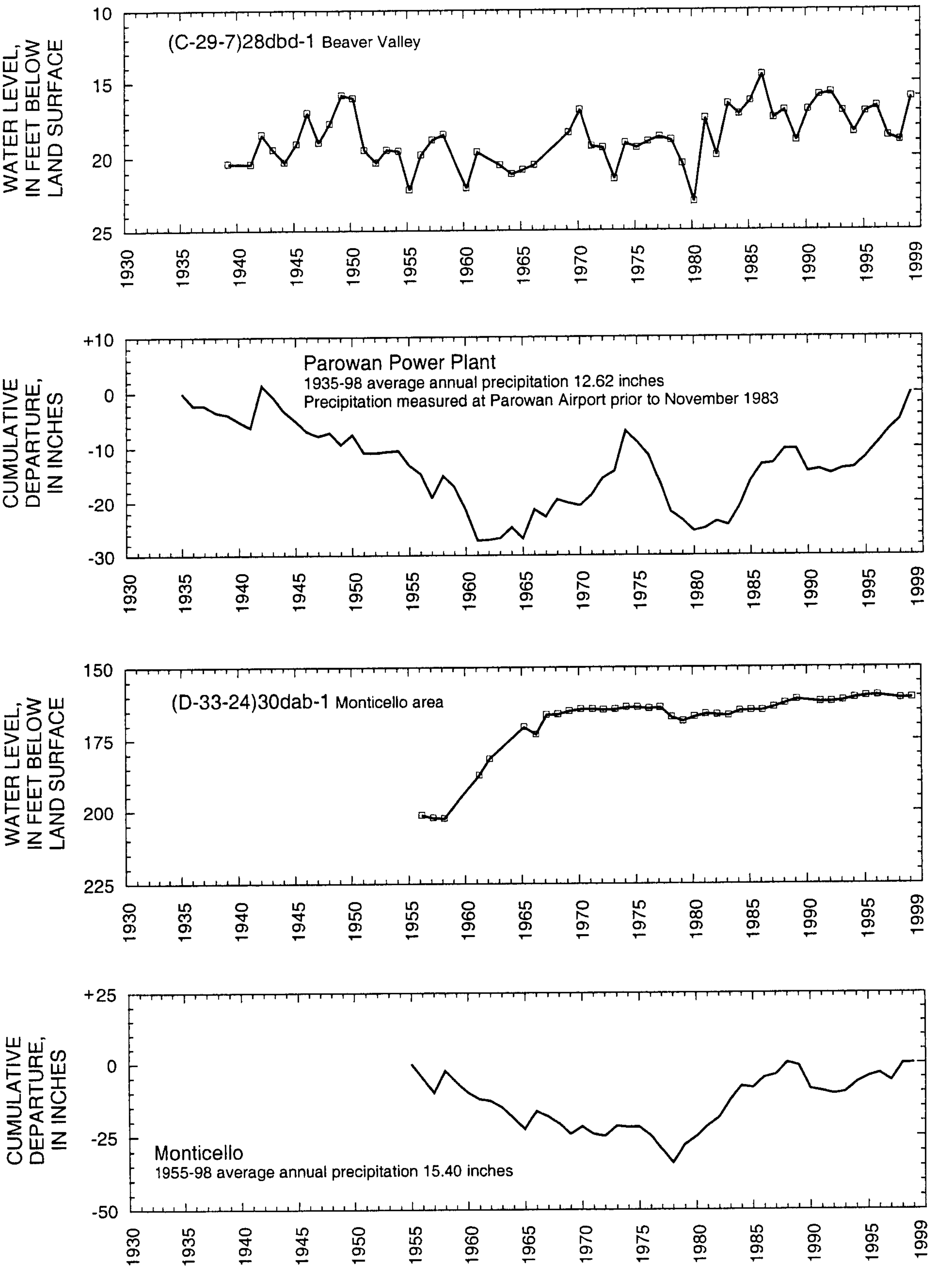


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

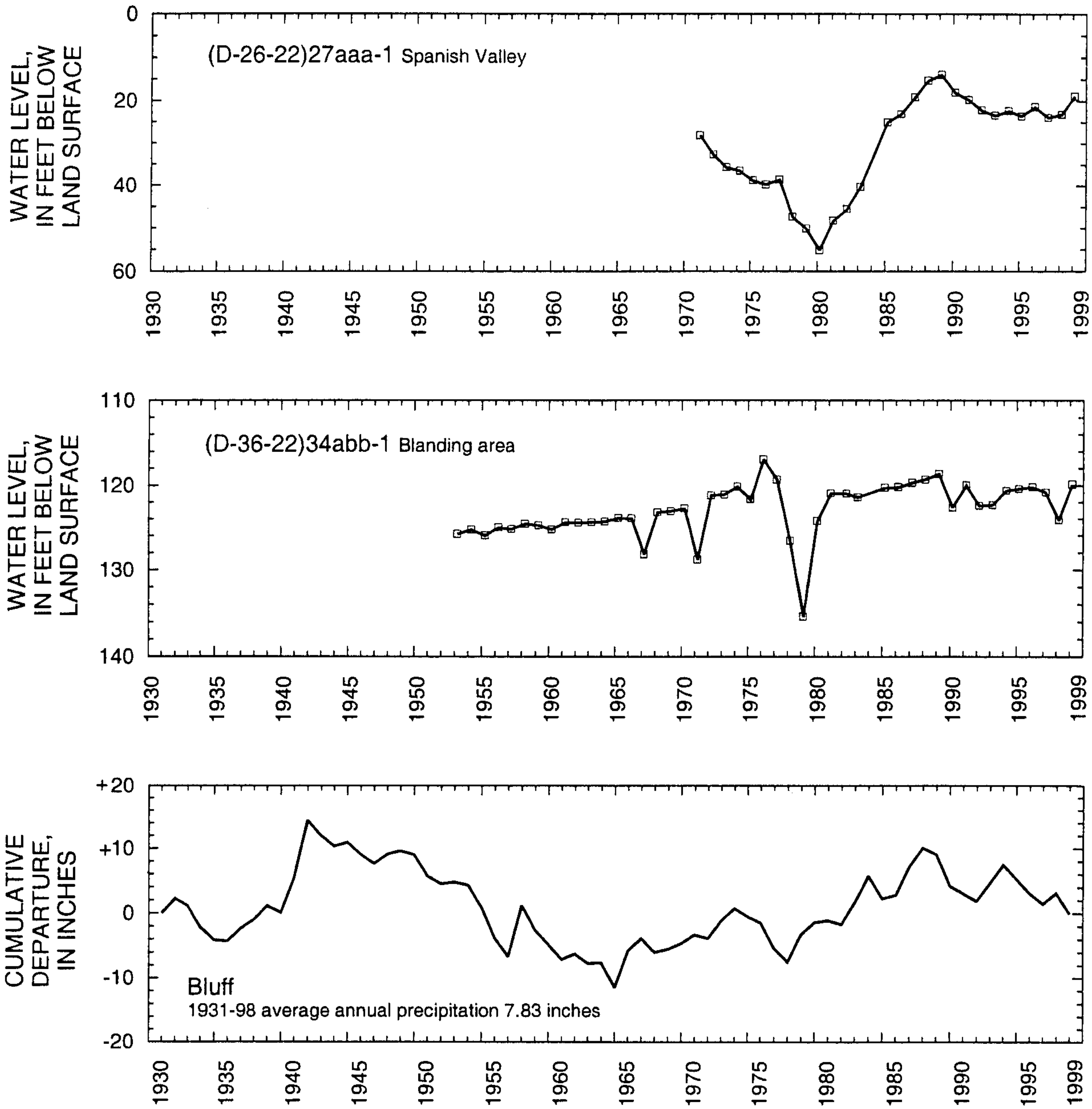


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

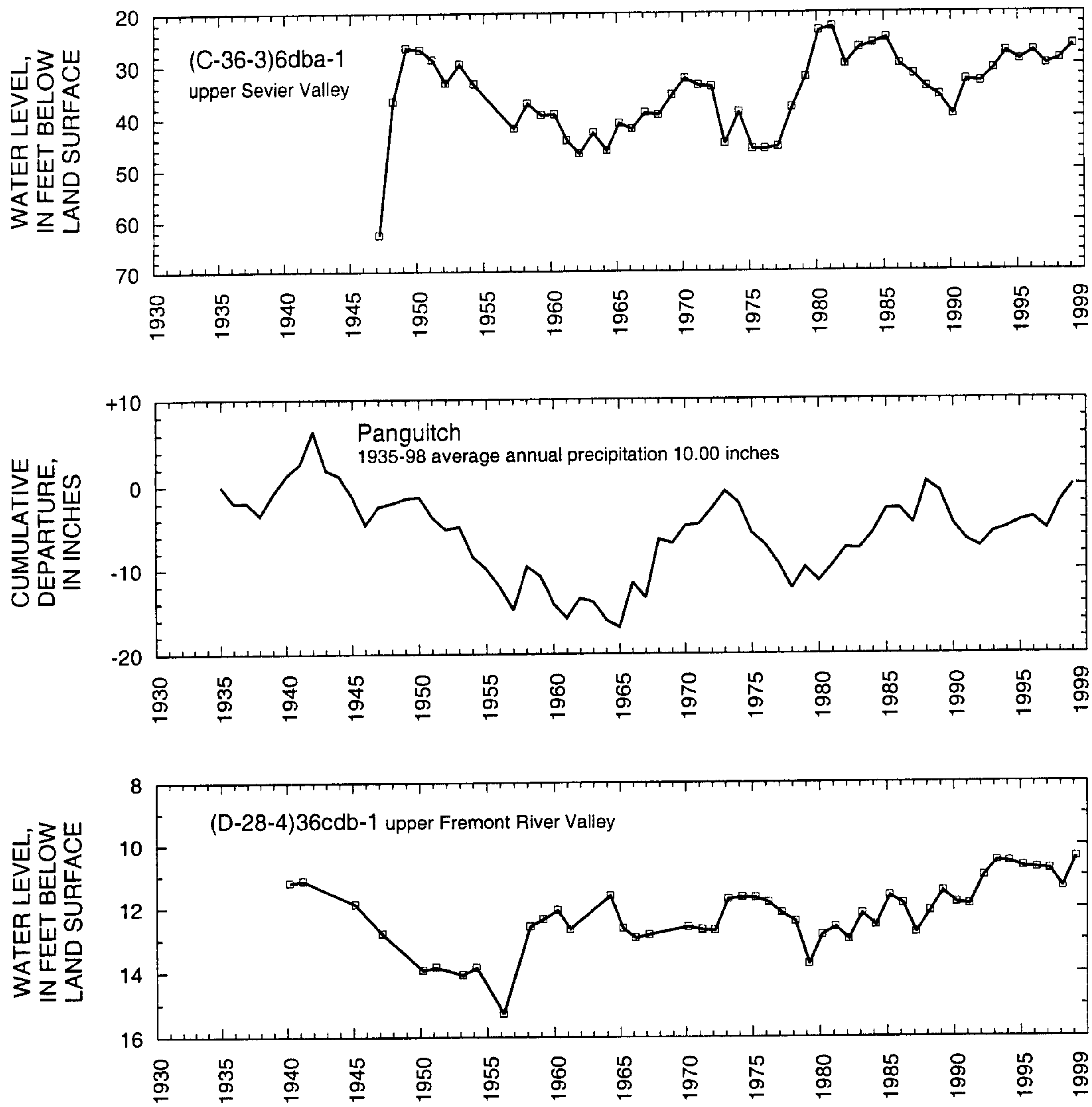


Figure 38. Relation of water level in wells in selected areas of Utah to cumulative departure from average annual precipitation at sites in or near those areas—Continued.

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